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Edited by ROBERTS BEAUMONT, M.Sc., M.I.Mech.E.

DRESS, BLOUSE, AND COSTUME CLOTHS

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DESIGN AND FABRIC MANUFACTURE

BY

ROBERTS BEAUMONT

M.Sc., M.I.Mech.E.

Professor of Textile Industries, Leeds University, 1889-1913; *Clothworkers' Inspector in Textile Technology,* 1892-1916; *Royal Society of Arts Medallist; Examiners' Medallist, City and Guilds of London Institute; Vice-President of the International Jury on Textile Machinery, Paris Exhibition,* 1900.

Author of "Woollen and Worsted," "Colour in Woven Design," "Union Textile Fabrication," "Standard Cloths," "Finishing of Textile Fabrics," "Woven Fabrics at the World's Fair, Chicago," "Apprêt des Tissus"; "Fabrication des Lainages," etc.

AND

WALTER GEORGE HILL

Honours Silver Medallist in Textile Technology, City and Guilds of London Institute

DRESS GOODS MANUFACTURER

WITH OVER 700 ILLUSTRATIONS, IN MONOCHROME AND IN COLOUR, OF YARNS, WOVEN SPECIMENS, AND DESIGNS

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PREFACE

The design and manufacture of Dress, Blouse and Costume Cloths comprise phases of textile technology obtaining in the different sections of the spinning and weaving industries. Dress goods are, for instance, made of materials and yarns which constitute the staple woven products of the silk, artificial silk, cotton, linen, worsted and woollen trades, but adapted in weaving practice to the construction of light varieties of fabric. Such goods form, as a result of these conditions, a unique and distinct description of textile manufacture, one which imposes on the producer a knowledge of the technology of each of these trades, in addition to a knowledge of fabric design, tinting, and finishing applicable to dress, costume, and blouse cloths.

In view of these salient features of the subject it has been sought in this work to interpret (1) the commercial and industrial aspects of the trade; (2) the nature, structure and the qualities of the yarns employed; (3) the weaving principles involved; (4) the design and colour schemes elaborated; and (5) the systems of fabric build and manufacture practised.

As far as possible a complete dissection of these problems has been attempted. Technical and working data are supplied bearing on the manufacture of (*a*) each standard class of dress fabric in cotton—plain, twill, and specialized in weave type, e.g. voiles, zephyrs, crêpes, flannelettes and sateens; in silk—cords, repps, satins, crêpe de Chine, brocades, velvets, etc.; in woollen and worsted costume fabrics—ordinary in weave and finish and distinctive in surface features, as in curl, ripple and waved cloths; in lustres—such as Sicilians, brilliantines, poplins and plain and figured textures; in linen, canvas and soft finished goods: and (*b*) relative to the manufacture of the many varieties of "fancy" and mixed-yarn fabrics, simple or special in weave structure, piece-dyed or coloured in the loom, and elementary in pattern style or decorative in design composition.

Considering briefly the arrangement and scope of the book,

there is given in Chapter I an analysis of the industrial range and trading interests, inclusive of information on the factors which make for manufacturing efficiency and commercial stability. The influence of fashion and of changes in textural pattern and style, and also of the effects on production of standardized factory routine are explained, with reference to the phenomena entering into and determining the trend of the home and shipping trades.

The value of the Yarn Unit—the materials of which it is composed and the methods of its manufacture—in fabric construction and design is explained and illustrated in Chapter II. Silk, in one form or another, is so extensively applied in the making of dress goods that it is treated of in a separate chapter, with an exposition of the manufacture of "thrown," "spun" and "artificial" silk threads.

In treating of Weave Elements, the systems of warp and weft setting are taken fully into account, and also the various weave structures and the types of intersection plans derived from the same. Drafted patterns of a striped, checked, and all-over arrangement are systematically examined, followed by the consideration of designs built on "weave," rectangular, lozenge, rhomboidal, transposed, circular and geometric bases. Spotted and mosaic styles are, in the first place, treated of in relation to a selected number of photographic studies, including an interesting series of Japanese examples. The point-paper production of "Spottings" in different makes of light textures, in cotton, worsted, linen, silk and mixture yarns, and as formed by warp, weft, and extra warp and weft threads, is dealt with in Chapter VIII. Practice in figure designing is introduced by studies in decorative ornament as exemplified in Sicilian, Florentine, oriental and modern fabrics. These are followed by the elucidation of the technique and the structural varieties of figured effects as developed in warp or weft, and in cloths special in build or compound in type.

The subjects of the different classes of pile fabric—velveteens, corduroys, velvets, astrachans, lambskins and figured velvets are analysed in Chapter X, as also the principles of gauze and lappet weaving and designing in different kinds of textures.

Throughout the work the utility and function of colour in the several classes of dress fabrics are illustrated and defined. Finishing methods and treatment are also specified in relation to certain makes of cloth, more particularly when they are responsible for the quality and style of the fabric originated.

Technical and scientific research, as it should be increasingly encouraged in the different departments of the industry, is suggested and elucidated, but for research, as it is competent of resulting in the production of new and economic grades of dress fabrics, reference should be made to *Union Textile Fabrication*.

The subject is fully illustrated by original designs and specimens, and the authors desire, in this connection, to express their indebtedness to the publishers for the manner in which these have been prepared and published.

They also appreciate the courtesy of Messrs. J. and T. Brocklehurst & Sons, Ltd., Macclesfield ; Messrs. Courtaulds, Ltd., Coventry ; Messrs. Reuben Gaunt & Sons, Ltd., Farsley ; Messrs. McLennan, Blair & Co., Glasgow ; Messrs. W. H. Potter & Co., Bradford ; and of Messrs. Sir Titus Salt, Bart., Sons & Co., Ltd., Saltaire, in supplying samples of worsted, mohair, alpaca, camelhair, silk, artificial silk, cotton, and other yarns ; and that of Messrs. Greenwood & Batley, Ltd., Leeds, in providing illustrations of silk preparing and spinning machinery. Further, they wish to acknowledge the suggestive technical paper on Artificial Silk of the late Mr. Leonard Wilson, F.I.C., embodied in Chapter III ; and the help of Mr. Arthur Snowden, Textile Interests, Ltd., Bradford, in the preparation of tabulated data on yarns and fabrics.

R. B. AND W. G. H.

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DRESS, BLOUSE, AND COSTUME CLOTHS

CHAPTER I

INDUSTRIAL AND COMMERCIAL ASPECTS

1.—Complex Industrial Formation. 2.—Textural Basis and Manufacturing and Design Schemes. 3.—Weave Schemes—Ordinary Groups of Fabrics. 4.—Colour Practice and the Fancy Trade. 5.—Elaborated Stripings and Checkings. 6.—Distinctive Phases of Colour Technique. 7.—Materials and Textural Applications. 8.—Silk Satins. 9.—Acquiring Suitability of Fabric Structure. 10.—Double and Compound Cloths in Dress Goods. 11.—Multi-ply Weft Figuring. 12.—Art and Technique. 13.—French Silks. 14.—Loom Mounting and Figured-Velvet Production. 15.—Doupe and Cross Weaving Examples. 16.—Lappet and Woven Lace Principles of Pattern Origination. 17.—Waved Surface Cloths. 18.—Interlaced Surface Effects. 19.—The Yarn Unit and Manufacturing Technology. 20.—Frisé, Ripple and Curl Manufactures. 21.—Printing and Embossing. 22.—Embroidery as an Accessory to Loomwork. 23.—Tinctorial and Colourization Practices. 24.—Natural-Coloured and Piece-dyed Goods. 25.—Pattern development in Cloths of Admixed-Yarn Types. 26.—Factors Controlling Commercial Stability—Home Trade. 27.—Fashion. 28.—National Purchasing Power and Factory Production. 29.—Influence of Economic Evolutions. 30.—Consolidation of the Home Trade. 31.—" Style " Transitions. 32.—Standardization in the Dress Industry. 33.—Shipping or Foreign Trade—Divisible into Two Sections. 34. Prestige of French Fashions and the Goods in Demand. 35.—Phenomena Affecting Trade in the Near and Far Eastern Countries. 36.—Board of Trade Intelligence and Foreign Trading. 37.—Provisions relative to Trade Intelligence and Dress-fabric Manufacture. 38.—British Industrial Centres.

1. *Complex Industrial Formation.*—Industrially and commercially, the dress trade presents distinctive features for analysis and study. It combines, in a fuller and more intimate relation than other branches of the textile industry, the varied technicalities of the cotton, linen, silk, worsted

1—(5264)

and woollen schemes of fabrication. In the latter, yarn and cloth construction are specific in character, and defined and restricted by the staple material employed. For example, in the worsted trade the yarn range is of a combed-wool formation, supplemented, in certain makes of cloth, by yarns of a carded-wool structure ; in woollen manufacture, the yarns are chiefly carded, condensed, and selfactor spun, and consist of wool fibre or of wool substitutes ; in linen production—all grades and sorts of texture from the fine cambric to the close-set and heavy damask—the warp and weft yarns are prepared from flax, or, in union linens, from flax and cotton ; and, in the silk trade, the yarns are produced in pure or raw silk, "waste" silk, and artificial silk, with, however, different groups of fabrics composed of silk and cotton, silk and flax, etc.

The intermixture of yarn structures, in such industrial divisions and practices, is more or less standardized, though strictly determined by the essential qualities of the predominant material in the commercial goods. On the other hand, in the dress-fabric industry, the yarn ingredients may be as diversified in filament composition, and in routine of preparation, as in all the several forms of manufacture referred to.

2. *Textural Basis and Manufacturing Schemes.*—This technological factor provides a broad textural basis, one capable of indefinite development and elaboration. Thus such yarns—single, folded, or multi-ply, and plain or varied in tinting and in surface features—are adapted to, and employed in, the making of blouse, dress, costume, and figured cloths by the following well-defined systems of fabric building and origination—

TABLE I

SCHEMES OF DRESS-FABRIC MANUFACTURE

I.—*Weave Scheme*, as in elementary principles of intertexture, and comprising (*a*) cloths in the natural colour of the raw material and (*b*) cloths in dyed shades.

II.—*Compound Weave Scheme*, as in the combinations of weave units in striped, checked, and geometrical patterns, and produced in cloths (*a*) and (*b*).

III.—*Colour Scheme*, as in coloured fancies (*a*) in ordinary weave plans, and (*b*) in special and compound weave elements, and woven in stripes and checks of different line groupings and line demarcations.

IV.—*Figured Scheme*, as in figured patterns coloured in the loom or dyed in the piece.

V.—*Decorative Scheme*, as in silk brocades, damasks, and velvets; also in decorative styles in many descriptions of union manufactures.

VI.—*Looming Scheme*, applied in the construction of leno, gauze, lappet, lace, net, and pile-woven effects in the fabric, inclusive of design elements in which ordinary schemes of intertexture are combined with one or more of these principles of loomwork.

VII.—*Surface Differentiation Scheme*, developed in the formation of textures possessing a curled, looped, waved, cut-pile or otherwise modified surface, and producible (*a*) by the yarns selected, (*b*) the weaving practice, and (*c*) by the finishing treatment in association with the routine of manufacture.

VIII.—*Printed and Embossed Scheme*, as in cloths in which the warp, weft, or both sorts of yarn, are colour printed for giving either a blotched, spangled or regular form of pattern; and in cloths with a soft, fibrous, but plain surface, on which a pattern is acquired by a process of embossing.

IX.—*Embroidered and Woven Scheme*, obtaining in the origination of fancy and figured goods in which assorted details of the style are applied to the textures after weaving on the embroidery frame, with other details loom constructed.

X.—*Tinctorial and Manufacturing Scheme*, as in producing cloths consisting of material units differing in tinting value, and in which the admixture of the several varieties of fibre is done (*a*) in yarn preparation, (*b*) in yarn doubling and twisting, and (*c*) in weaving by combining, in the warping and wefting, threads made of different classes of material. The goods, while woven in the grey, take, in piece-dyeing, mixture tints, tones and shades.

This synopsis of the commercial and manufacturing phases of the industry, affords a general conception and view of the technical principles and practices covered, and also of the looming and design schemes involved. The yarn factor, that is the filament quality and consistency and surface conformation of the kind of yarn employed, will be dealt with in respect to the weaving of standard makes and other

descriptions of blouse and dress fabrics ; and need not, therefore, be dissected and explained in this connection. It is, however, expedient that some of the industrial differentiations, suggested in the groups of manufactures tabulated, should be reviewed. Being illustrative of the dress trade, it is essential that the special aspects and applications of the several schemes should be indicated and understood.

3. *Weave Schemes—Ordinary Groups of Fabrics.*—Examining them for this purpose and leaving the fuller analysis of each scheme for subsequent study, it has to be observed that Schemes I and II obtain in the production of ordinary fabrics in all sections of the textile industry, but, in the dress trade, Scheme I includes such staple textures as—

(1) Lustres—Sicilians, Orleans, glacés, brilliantines, poplins, serges, linings, etc.

(2) Crêpes, cords, repps, gabardines, delaines, etc.

(3) Crimps, muslins, and light or thin cottons.

(4) Plain and twilled silks, satins and sateens, and fabrics composed of silk or artificial silk and cotton, silk and linen, and silk and worsted or woollen.

(5) Worsted and woollen costume cloths ; also union costume cloths in which worsted and woollen yarns are the chief thread ingredients.

Scheme II is extensively developed in piece-dyed and natural-tinted fabrics made of silk, cotton, linen, worsted and mixed yarns. It provides for the origination of pattern style in weave elements, as in modified plain and twilled weaves, mats, cords, sateens, diaper, diamond, lozenge, and other effects, as well as designs consisting of two or more principles of intertexture, and arranged on a striped, checked, rhomboidal or geometric base. While the cloths are not standardized in pattern form, inasmuch as they are devised and produced for current consumption, they constitute important branches of manufacture in lustres, thin cottons, silks, linens, worsteds, and unions.

4. *Colour Practice and the Fancy Trade.*—Scheme III is

utilized in the construction of the various classes of coloured fabrics acquired in each division of "fancy" textile manufacturing; but it is also representative, in the dress industry,

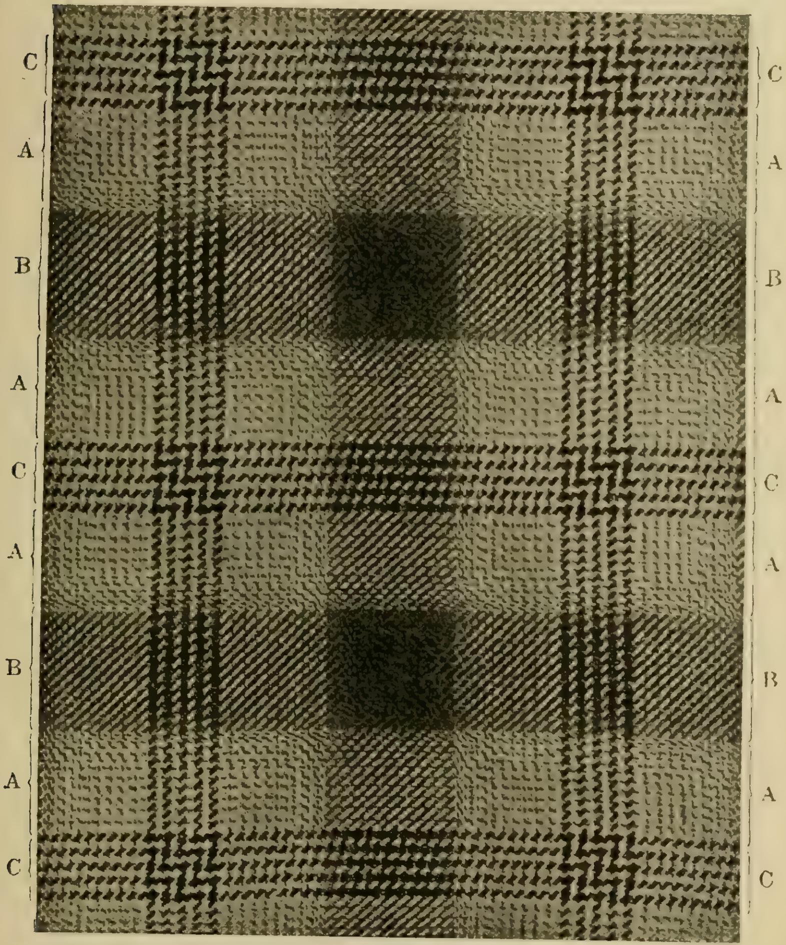


FIG. 1.—SHADED CHECK IN WORSTED YARNS.

of certain distinctive systems of looming practice. First, the textures require to be of a suitable lightness and flexibility. Firmness and super-compactness of structure are not, as a

rule, advantageous, but rather softness of surface and suppleness of handle, combined with a serviceable degree of wearing durability. Second, with the patterns of a striped, spotted, and checked order, it is obvious that many of the methods of yarn-grouping, adopted in the weaving of woollen and worsted suitings, coatings and trouserings, may be employed, but with marked variations in colour treatment. Thus the styles should be more clearly delineated though of the same structural arrangement, with the colour contrasts and tones in keeping with the garment applications of the cloths. In addition, the patterns may be broader and more elaborate in composition than those observed in the ordinary classes of woollen and worsted fabrics. To illustrate these technicalities—the shaded check compound in Fig. 1 is, in construction and design elements, a form of pattern effective in either worsted dress fabrics or woollen rugs ; or in two descriptions of cloth so dissimilar in substance, character, and applicability, as to render a different colour scheme imperative in the development of the pattern in the respective manufactures. For the former brighter and richer tinting is requisite than in the latter, but in each harmony of tone is all important.

5. *Elaborated Checkings and Stripings.*—An examination of the order of warping and wefting for the specimen, which is shown on page 7, will enable the technical qualities of the colouring of dress goods, as distinguished from those of other textiles, to be discriminated and defined.

Substituting a tint—say lavender—for white, a tone (medium blue) for grey, and a shade (navy blue) for black, the pattern would consist of a lavender-tinted ground shaded with medium blue and overchecked with navy ; or it would be woven in analagous colourings. In the dress trade, pure colours, such, for illustration, as those distinguishing the original tartans, are also combined. Depth and strength of colour contrasts, due to the admixture of different coloured hues as well as to the admixture of colour tones and tints, are more common, and classified in larger areas of effect, than in

Specimen Fig. 1. Order of Warping and Wefting

4	threads	of	black	32	threads.
4	,,	,,	white		
4	,,	,,	black		,,
6	,,	,,	white	14	,,
1	thread	,,	grey		
5	threads	,,	white	12	,,
1	thread	,,	grey		
4	threads	,,	white	10	,,
1	thread	,,	grey		
3	threads	,,	white	8	,,
1	thread	,,	grey		
2	threads	,,	white	6	,,
1	thread	,,	grey		
1	,,	,,	white	6	,,
1	,,	,,	grey		
8	threads	,,	grey		
1	thread	,,	black	6	,,
1	,,	,,	grey		
2	threads	,,	black	6	,,
1	thread	,,	grey		
3	threads	,,	black	8	,,
1	thread	,,	grey		
8	threads	,,	black		
1	thread	,,	grey	8	,,
3	threads	,,	black		
1	thread	,,	grey	6	,,
2	threads	,,	black		
1	thread	,,	grey	6	,,
1	,,	,,	black		
8	threads	,,	grey		
1	thread	,,	white	6	,,
1	,,	,,	grey		
2	threads	,,	white	6	,,
1	thread	,,	grey		
3	threads	,,	white	8	,,
1	thread	,,	grey		
4	threads	,,	white	10	,,
1	thread	,,	grey		
5	threads	,,	white	12	,,
1	thread	,,	grey		
6	threads	,,	white	14	,,
1	thread	,,	grey		

other branches of manufacture in which the goods are designed for clothing purposes. Hence, the colouring characteristic of the Rothsay (red, green, and white), the Barclay (blue, red, and green), the Forth-Second (indigo blue, green, and black), and other plaids, might be effectively applied to this checking. Thus, adapting the colour assortment in the Rothsay tartan, white, as in Fig. 1, is usable in the field of the specimen, shading with green and weaving the 4-and-4 lines in black; or red in the ground toned with black and overchecked with white. In the case of the Barclay, red is applicable to the ground, taking the place of the white yarns in the warping and wefting, green to the shaded details, and white to the overchecking; and in that of the Forty-Second, green in the ground, blue in the shading, and black in the overchecked features. Selecting further colour units, as heliotrope for white, sage green for grey, and ochre brown for black, or light fawn for white, tan for grey, and purplish-blue for black, light-tinted and medium-toned patterns would be formed of a colour composition and quality chiefly useful in dress cloths.

6. *Distinctive Phases of Colour Technique.*—It is clear from this example in Scheme III that, with the adaptation of a style, applicable to several varieties of woven fabrics, to dress designing, colour technology offers distinctive phases of study, as in the freshness and richness of the hues employed and in the systems of colour grouping developed—bright tinting being practised in the ground and in the details of the patterns originated. With, however, the subject of colour considered relative to the dress trade purely, it will be shown that the scope for patternwork is greatly widened as it is affected by colour gamut and assortment, by diversification in striping and checking, and by range in style composition. In a limited degree this is evident in Fig. 1, for whether examined as a checked combination or as a striped design—e.g. sections A, B, and C—it is typical of the elaborate and ingenious orders of warping and shuttling feasible. A more complete analysis

of the textural principles and colour groupings involved would emphasize the peculiar value and utility of colour as a primary design ingredient, and as a fundamental element in pattern structure, in all classes of "fancy" dress cloth manufacture.

7. *Materials and Textural Applications.*—Considering Scheme IV, it has two principal aspects—the materials usable and the textural applications. One elementary group of fabrics here comprised is that in which the warp yarn is cotton and crossed with alpaca, mohair, or lustre weft; and cotton or fine Botany worsted warp yarns woven with silk or artificial silk weft yarns. The styles range from sateen or geometric plans of simple figure distribution to styles composed of floral and leaf details of a strictly conventionalized form and method of treatment. The cloths are plain in the ground with the design features acquired by floating the weft yarn in sateen, in twilled or in other common principles of intertexture. Other types of fabric are more diversified in the yarn units, looming practice, and in systems of colouring. Four specimens will be examined—Figs. 2, 3, 4, and 5. They are suggestive of the woollen, silk, cotton and silk, and of the cotton, worsted, and silk methods of manufacture. The tweed specimen—Fig. 2—is made of woollen yarns, namely, twist threads in the warp and mixture-shade threads in the weft. In carded-yarn cloths the weaves combined require to be of a simple twill, mat, or plain variety. The example is $\frac{3}{1}$ twill in the ground and $\frac{1}{3}$ twill in the wave lines forming the figuring. Piece-dyeing may be practised in such goods, when, by using worsted yarns in the warp and shuttling with woollen yarns, the degree of differentiation in the qualities of the woven surface, due to each kind of yarn, is sufficient to accentuate the design structure in the finished fabric.

8. *Silk Satins.*—In contrast with this comparatively coarse grade of figured but thin cloth—12 to 13 oz. per yard, 54 ins. wide—obtained in carded woollen yarns, openly set in the reed, the silk satin, in Fig. 3, may be taken as exemplifying the

finer build of figured textures, but also elementary in weave formation. Silk designing, in dress, blouse, necktie, and

FIG. 2.—FIGURED TWEED COSTUME CLOTH.

decorative manufactures, is illustrative of the higher branches of technique and art as applied to loomwork. Here the ingenuity and skill of the technologist are associated in the fullest ratio with the imaginative force and executive faculty

of the decorative artist. There is no fibrous material which offers such freedom and facility in the delineation of woven ornament, and in the origination of richness of tinting in the tissue, as silk when prepared in the quality of *organzine* for warp, and in the softer and more diffusive quality of *trame* for weft.

9. *Acquiring Suitability of Fabric Structure.*—As in the general practice in dress-fabric weaving, it is essential, in silk goods, to produce a sound textile structure, and also to develop

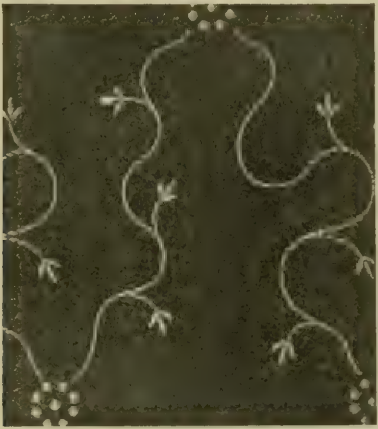


Fig. 3.—Silk Satin Texture.

distinctly the outlines and small effects of which the style consists. The minutest details need to be smartly delineated, or with a corresponding definiteness and accuracy as if painted on the woven surface, yet with that beauty of toning rendered possible by the intersection of warp and weft threads. These technicalities necessitate close setting in the loom, and the selection of weave plans, for the ground and figuring, in strong contrast with each other, such as, a warp-face sateen for the former and a weft-face sateen for the latter. This represents the weave structure of the specimen, Fig. 3, with the addition of floating the weft solid in forming the twig and stem parts of the design. Textural fineness and durability

are acquired in this and similar makes of fabric, by (1) full setting in the loom—in the example 340 threads and 120 picks per inch; (2) by the employment of two wefts—ground and figuring; and (3) by the scheme of fabric construction or by the weave units selected.

10. *Double and Compound Cloths in Dress Goods.*—That double and compound builds of cloth should be applied in

Fig. 4.—Cotton and Silk Compound Fabric Structure.

the formation of light textures is due to the various systems of setting possible in looming, and to the sorts and counts of yarn combinable in weaving. An explicit method of work is shown in Fig. 4. This double-plain make of dress goods consists of thick, folded cotton and of fine silk yarns, arranged, in the warp and weft, 7 threads of silk to 1 thread of cotton. Both sets of threads interlace in plain order, but each group of yarns yields a separate texture, that in the cotton being open and loose, and that in the silk fast and dense, in thread

composition. For the development of the pattern, the silk-woven texture is brought on to the face in the figuring, and the cotton-woven texture on to the face in the ground. This

Fig. 5.—Extra Weft Figured Cloth.

relation of the two textures obtains throughout the weaving of the piece. It follows that the underside of the compound cloth is the opposite in effect and in appearance to the upper side, making it "reversible" and actually usable on either surface.

11. *Multi-ply Weft Figuring.*—With the assortment of worsted, cotton, and silk yarns, employing cotton in the warp,

the fabrics may be multi-ply in the weft, yet thin and light in construction as seen in the example given in Fig. 5. The specimen typifies the weft principle of figured cloth construction, being produced in three wefts, blue and straw-tinted silk, and light fawn worsted, interlacing with the greenish-grey cotton warp yarn. Similar descriptions of texture and design are also feasible in the warp principle of figured weaving, in which instance several chain beams are used, as for the silk and worsted threads respectively. The relative merits of the two principles of intertexture will be discussed in their proper place. It may, however, be observed that the multi-ply shuttling arrangement, as here illustrated, affords certain advantages in acquiring fineness, compactness, and quality of fabric build. But the leading technicality it is now the object to punctuate is the diversity of weaving practice exercised in this grade of fabrication, particularly as exhibited in the yarn units, the structure of the cloth, and in the whole system of manufacture.

This specimen, and the specimens in Figs. 2, 3, and 4, suggest the field of application of Scheme IV, but by no means represent the designing and productive technology in figured dress textiles. Still they serve to demonstrate the range of textural work implied in acquiring makes and varieties of cloth of a definite commercial value and serviceability.

12. *Art and Technique.*—Decorative fabrics for court robes and like purposes (Scheme V) do not literally come within the scope of this treatise, but as they result from the selection, combination, and practice of the weaving principles utilized in the manufacture of the different kinds of dress goods, their distinctive characteristics demand some explanation. For affording this, reference will be made to the French examples in Figs. 6, 7, and 8. The two former are illustrative of silk brocades, and the latter of decorative velvets with a satin ground.

Artistic and technical faculty is evident in the style origination of these designs as also in the draughtsmanship exercised

FIG. 6. FRENCH BROCADE, MODERN STYLE.

in the planning, drawing and distribution of the figuring, and particularly in the conventional treatment of plant form. But the real excellence of the decorative composition is revealed and emphasized in the textural schemes combined

FIG. 7.—FRENCH BROCADE.

in the origination of the design elements. Other methods, for example, of expressing the latter in warp and weft interlacings might have been applied in Fig. 6, but those selected are strictly in harmony with the decorative qualities of the style. Looming technology is illustrated as adding richness, novelty and unity of tone, first, to the integral parts of the pattern, and, second, to the complete plan of ornamentation.

Weaving technique, in this instance, assumes its legitimate

province, that of producing a fabric of the correct build and fineness, with suitable variations in surface treatment for the effective development of the component sections of the design. It is seen in the weave details, the groundwork being a 16-end sateen, and the figured elements—stem, leaves and petals—in special types of intertexture ; while the choice scheme of colouring applied conforms with the clear delineation of the leaf figuring developed in fancy and original weaves. Dissecting the textural plans combined, the stem work results from employing solid floats of weft, edged with warp cord. The petals of the flowers are woven in flushes of weft—varying in length according to the emphasis it is desired to give to each detail—and in mat and repp weaves. The shading of the leaf figuring is mainly on the twilled principle, with floats of warp for defining the veins, and with a fast rib ground for importing flatness of tone.

13. *French Silks.*—French decorative silks are invariably illustrative of (1) correctness of manufacture ; (2) structural adaptability ; (3) design freshness and merit due to " weave " details and " weave " composition ; (4) originality in pattern attributes and style ; (5) harmony of colour tinting and tone ; and (6) richness of quality in finish or commercial get-up.

Fig. 7 is suggestive of these several characteristics. It is a decorative style with a fine repp ground in a silver-grey tone of colour, and with the interior sections of the figuring in a light tint of warp, and woven in sateen. The pronounced contrast between the compact floats of weft—forming the edging of the pattern features, and also the line details—and the effects in warp sateen, bring out every section of the design. While the decorative forms of the pattern are skilfully executed, the beauty of style expression is a derivation of weave structures, counts and qualities of warp and weft yarn, and of accuracy in fabric setting.

14. *Loom Mounting and Figured-Velvet Production.*—Another form of technique predominates in the origination and manufacture of the decorative grade of velvet texture illustrated in

Fig. 8.—Velvet and Terry Pile Figuring on a Satin Ground.

Fig. 8. Fabric build, rather than fabric diversification by weave assortment, is the salient branch of textile study here typified. Loom-mounting, as exercised in the making of this kind of woven product, involves (*a*) the utilization of the full harness capacity in the development of the figured design; (*b*) the use of a set of heddles in front of the harness for weaving the ground of the cloth; and (*c*) the control, by means of special wires in the Jacquard machine, of a series of metal or wooden staves, inserted into the harness below the comber-board, for enabling the mails of the harness to be operated in serial groups in any determined order, or to correspond, in warp shedding, to a set of heddles, with, however, the staves remaining inactive during the process of lifting the warp for the origination of the pile figuring.

In the second place, this scheme of loom-mounting involves the individual tensioning of the pile warp yarns by winding each thread on to a separate reel or double-headed bobbin, made equal, in the resistance it offers to the delivery of the yarn, to a small chain beam frictionally governed; and also the tensioning of the satin and foundation warps by the use of ordinary beams independently actuated; and thus providing for the regulation of the let-off of each kind of yarn as necessitated in the weaving routine. Work of this nature, as that concerning compound harness and shaft gearing, is purely technical in character, but requires to be devised and planned to coincide with the fabric data and structure, with which the design draughting must, moreover, be in perfect agreement.

There are obvious distinctions between this form of technology and practice and that relating to Scheme VI. "Looming" covers the system of healding or of entering the threads of warp into the healds of the shafts or the mails of the harness; and the mechanical motions and devices employed in obtaining, as in the lappet, gauze, and net effects, the decoration on the face of the cloth with yarns additional to those ordinarily used in the warp and weft; and also the means employed in the production of textures with a waved, watered

or sinuous surface, and caused by the displacement of the warp threads, in weaving, from the normal or straight line.

15. *Doupe and Cross Weaving Examples.*—By the first of these means—the employment of doupe healds—fabrics are producible of a more or less perforated formation. The

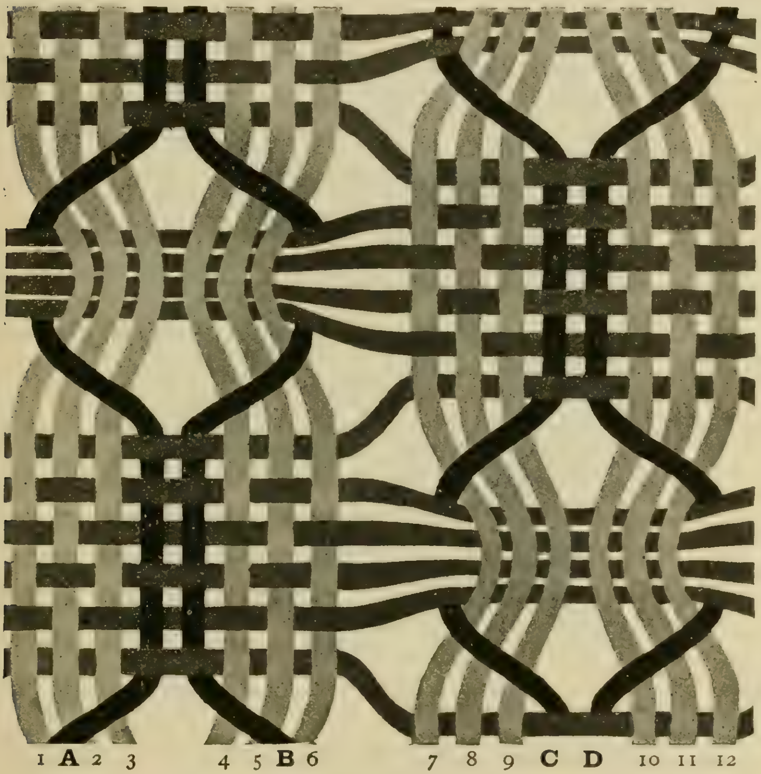


FIG. 9.—GAUZE STRUCTURE.

douping yarns—which may be of a like or dissimilar counts, and quality of fibre, to the yarns making the texture proper—successively intersect with the shots of weft on the right and left side of selected warp threads, interlacing plain or in some simple order. Thus, in Fig. 9, threads A and B and C and D "whip" or "twist" alternately from one side to the other of ends 1, 2, and 3, and 4, 5, and 6; and 7, 8, and 9, and 10, 11,

and 12, giving a gauze cloth of a definite open and varied structure. Or the doupe yarns may be actuated in series as in Fig. 10, when three ends, *a*, *b*, and *c*, intertwine with three adjacent threads, *d*, *e*, and *f*, with the shots of weft interlacing 3 and 3 and in regular sequence in Parts A; and with the thick pick 2 binding the crossing of four groups of whip threads in part B.

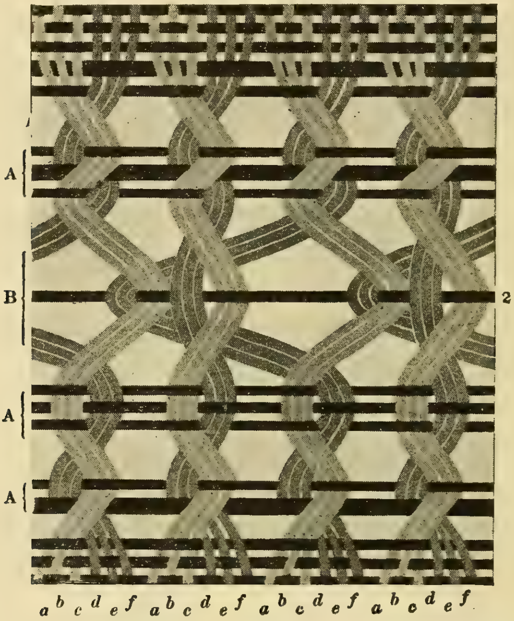


FIG. 10.—MULTI-YARN CROSSING IN GAUZE FABRIC.

When it is considered, first, that the practice in working the doupe threads may be diversified indefinitely; second, that the textural effects acquired may be united with plain and other woven types in the weaving of striped, checked, and figured goods; and third, that compound gauze and ordinary makes of cloth may be produced—such as fabrics having a gauze surface and a plain or twilled texture underneath—the extended usefulness of the gauze principles of weaving will be understood.

16. *Lappet and Woven Lace Principles of Pattern Origination.*—Gauze weaving, as a scheme of intertexture differs greatly from that of lappet weaving, in that the cloth structure is entirely a resultant of shedding with shafts, or harness, comprising doupe or half healds, which allow of the whip threads being transferred, according to the manner of

FIG. 11.—LAPPET FABRIC.

healding and sleying, from side to side of certain ground warp yarns; whereas, in the lappet arrangement, frames or needle bars, through the eyes of the pins or needles of which the threads pass, are placed in front of the sley, and on the lateral movement imparted to the frames depends the features seen in the fabric. In other words it is the function of the frames to spread the lappet yarns on the face of the cloth, lifting and depressing them concurrently with the shedding of the warp. The amount and sequence of the

traverse of the threads is determined by the extent and manner in which the frames are operated by the cam or other automatic mechanism of the loom. In Fig. 11 the frames have been worked to yield a lozenge-shaped style in parts A which, it should be observed, is a distinct product of the lappet motion. It has the appearance and structural character of a pattern acquired by floating the weft yarn. This arises from the side-to-side displacement of the frames laying the lappet yarns in a line with the shots of weft, and not in a line with the threads of warp. Many varieties of cotton, linen, silk, and mixed goods are adapted for this class of pattern treatment as will be subsequently demonstrated.

17. *Waved Surface Cloths.*—To produce the waved-surface class of fabrics—also included in Scheme VI—the ondulé reeds of the sley (Fig. 12) are of a special shape or design, and the sley is automatically moved up and down or in a vertical plane. The threads of warp are thereby made to change their position in the line of the fabric. The plan of intertexture is not varied, but this movement of the threads develops sinuous or waved characteristics in the piece. Usually the cloths are made of fine yarns and moderately well set, so that, however slightly the warp yarns are affected by the form and movement of the reeds, the fabric tone and appearance are modified.

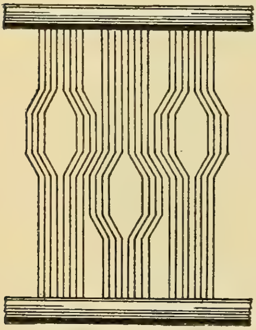


FIG. 12.

18. *Interlaced Surface Effects.*—Without having recourse to the doupe mounting, lace and net effects may be woven by combining threads and picks of a suitable thickness and sort of yarn with the threads used in constructing the several sections of the fabric. These yarns are floated more loosely on the upper side of the texture than those of which the warp and weft are chiefly composed. They may be knit together in

a variety of plans of interlacing to form different net structures, such as oval, circular, and irregularly-shaped. The network is weavable in sectional parts, or it may be distributed over the entire surface, of the fabric. It is developed in silk yarns on cotton, in mercerized cotton on worsted, and in mohair yarns on woollen textures.

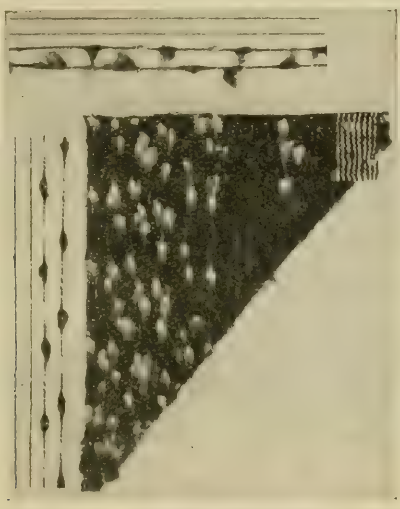


FIG. 13.—RAISED KNOPPED YARN COSTUME CLOTH.

19. *The Yarn Unit and Manufacturing Technology.*—Other manufacturing and designing principles and technicalities come into prominence in Scheme VII, than those paramount in the schemes of textural construction and patternwork examined. These principles are combined with the systems of yarn making and of yarn structure and composition ; with the practice in cloth production as caused and fashioned by the fibrous materials used and admixed ; and with the qualities and features obtainable in the woven or knitted fabrics as the consequence of finishing treatment. It is not intended, in this place, to more than briefly describe the branches of technology comprised, and the classes of goods to which Scheme VII is applicable.

Primarily, it should be observed that it is not generally sought, in such manufactures, to obtain effects in the textures by different plans of interlacing warp and weft, or by pattern as understood in the combination of ornamental forms, but to make a cloth of such a consistency and structure that, in the processes of finishing, diversity of surface will be developable. Fancy or plain yarns may be employed; but, in filament property and density, they must be subservient to the nature

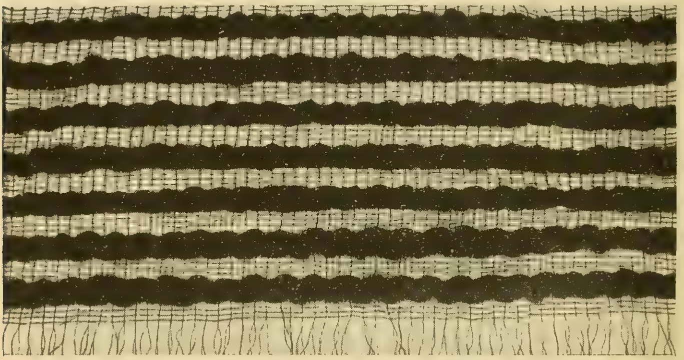


Fig. 14.—Gimped-Weft Veil Tissue.

and sort of fabric surface it is intended to produce in the processes of finishing. Thus knop, curl, flake, and other irregular threads are used for emphasizing the textural features as in Fig. 13, where knop yarns have been interspersed in the warp. By selecting mohair for the "knop" characteristic, the long, lustrous fibres of this material are drawn or trailed on the face of the cloth in the operation of raising. Of the different kinds of folded-yarn patterns, applied to this and similar makes of texture, and also to other light fabrics not changed in appearance after weaving, such as that in Fig. 14 (a gauze specimen lined across with a thick gimp weft yarn), analyses will be given; but it is now more especially to the manufacture of the "ripple," "wave," and the "curl" grades of cloth that come into consideration. From the ordinary soft

fibrous face type of cloth in Fig. 15, to the types illustrated in Figs. 16 and 17, it is a problem of fabric structure in the right sort of yarn for the method of finishing to be adopted.

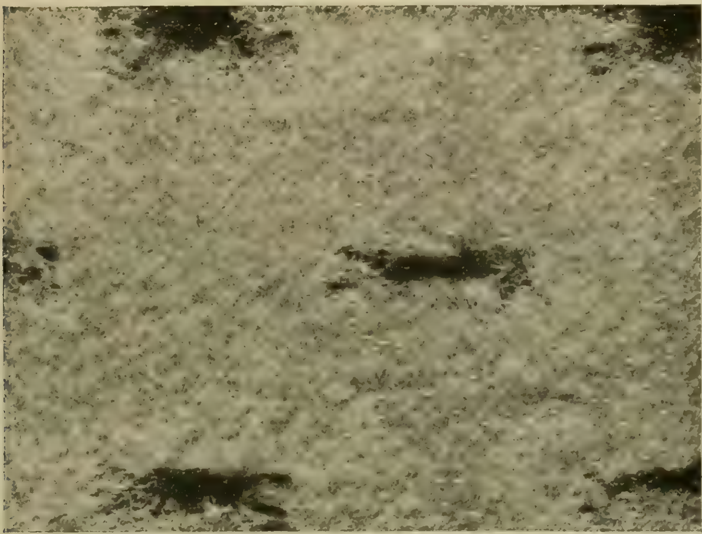


FIG. 15.—FIBROUS-FINISHED CLOTH.

20. *Frisé, Ripple, and Curl Manufactures.*—For producing a full nap of fibre the yarns, forming the face of the texture,

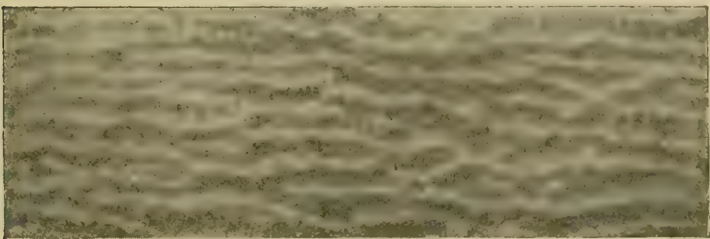


FIG. 16.—RIPPLE CLOTH.

not only need to be of the correct counts but made of a suitable fineness and length of material. To make these points clear the style in Fig. 15 may be first examined. It is woven in the 4-end broken $\frac{2}{2}$ twill, and shuttled with a soft-spun

woollen yarn, with the indented spottings in picks of mercerized cotton, a yarn less suitable for raising action. With a small degree of felting, a cloth is acquired on which the nap or pile may be readily and uniformly developed as seen in the specimen. For producing a "ripple" surface (Fig. 16) the cloth is similarly constructed, but raising is done with the pieces in a moist condition; and, after the pile has been formed, the pieces are treated on the napping machine to give the wavy surface. Yet different practices in cloth

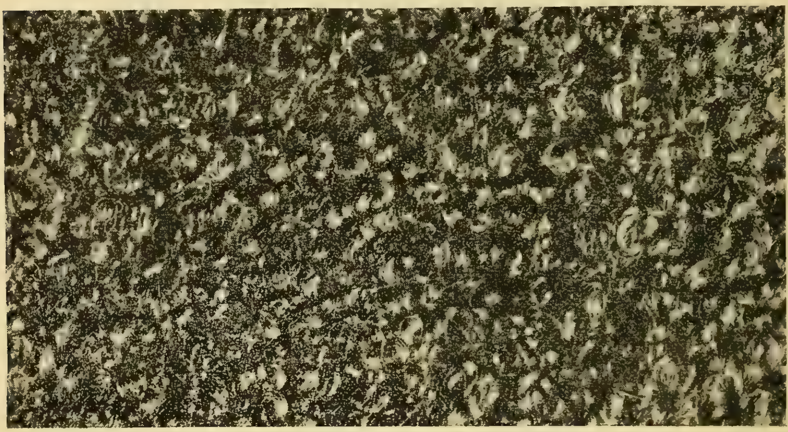


Fig. 17.—Curl-Surfaced Texture.

making, and in yarn assortment, obtain in fabrics having a looped or curled face characteristic—Fig. 17. This structure is made in cotton warp and mohair weft yarn. Each shot interlaces with, and floats over, a number of warp ends in succession, so that, in the shrinkage of the piece, the floating picks buckle or loop on the surface, when the form, dimensions, and frequency of the "curls" produced depend on the plan of intertexture and the nature of the weft yarn used.

21. *Printing and Embossing.*—Printing and embossing (Scheme VIII) are practised for attaining two distinctive objects in the manufacture of dress and costume cloths. The finest and thinnest—voiles and silks—as well as many classes

of dress and blouse textures, are printed either in the yarn, or in the piece, for the purpose of tinting, or of producing, the pattern style. But only the pile-finished costume cloth is adapted for the embossing operation ; and it yields a blocked-out pattern in the same shade as the dyed piece, though of a different tone. This change in toning is caused by the suppression of the pile of fibres by the embossing rollers,

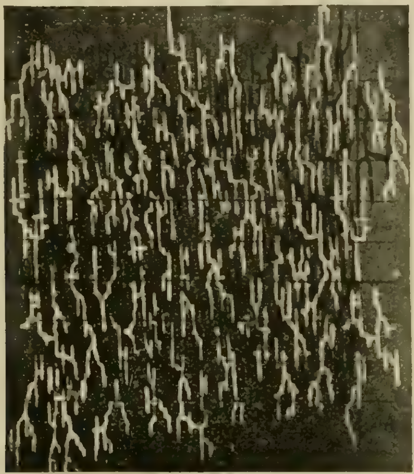


Fig. 18.—Printed Type of Design.

resulting in the lateral sides of the fibres being, in such positions in the texture, exposed to the light ; whereas, in the groundwork or unembossed parts of the fabric, the ends of the fibres appear in dense formation. Embossing does not, therefore, enhance the colour tinting of the piece in the same way as the printing process. Its function is to give a pattern impression, fairly permanent, on an otherwise plain but raised nap surface ; while the function of printing is either to yield a part or the whole of the colour composition of the design style.

Such types of effect as that observed in Fig. 18 may be the sequence of printing the warp yarns prior to weaving, or of printing the goods after cleansing. Taking the former

as the method, the yarns require to be grouped, in the loom, in the order in which they are intended to develop the pattern details in the fabric. For the latter method, the cloths are plain woven or made in the white or grey. The printed-yarn practice provides for variations in textural colouring in the looming, but does not offer the same advantages as the printed-piece practice, for determining the colour ingredients of the manufactures as the commercial requirements may impose.

22. *Embroidery as an Accessory to Loomwork.*—Embroidery (Scheme IX) constitutes a special branch of textile art, which is, from time to time, in vogue in both the plain and figured dress trade. It need only be briefly noted here. On the finished fabric, of a suitable material and make, the decorative plan—usually consisting of detached figures—may be freely executed in selected colourings. As an adjunct to loomwork, embroidery is an effective and economical method of obtaining on a prepared texture, which may be expeditiously manufactured, simple or elaborate styles of pattern.

Any variety of fabric with a plain, twill, or fancy weave surface may be thus treated. The specimen (Fig. 19) is of the voile description. One utility of the practice obtains in the readiness with which the added ornamentation is producible; and in the development of the effects which it contains, with a minimum length of the silk or other special yarn applied. In this it differs from weaving, where the shuttle—unless a swivel batten is employed—charged with the weft thread, for constructing the sectional parts of the design, travels from selvedge to selvedge of the piece, though it may only distribute, on the face of the texture, a fraction of the length of the yarn utilized, that not appearing in the pattern being concealed from view. Moreover, should the figuring yarns be inserted in the warp they necessarily extend the whole length of the cloth, so that either of these methods of weaving spotted and figured designs, entails an excessive consumption of the supplementary and costly yarns. On

the other hand, the embroidery frame only involves the stitching with the extra coloured threads over such parts of the fabric as are actually covered by the pattern; and it enables the decorative elements to be planned in fixed line

FIG. 19.—EMBROIDERED VOILE.

order, on a drop basis, or in particular sections of the width and length of the piece.

23. *Tinctorial and Colourization Practices.*—The progress made in recent years in dyeing, and in the application of chemical science to tinctorial methods and processes, has been followed by the systematization and expansion of the technological units of work comprised in Scheme X. The forms of practice therein implied, penetrate the whole field and organic plan of textile manufacture from the selection

of the raw material to the finished goods, including the systems of blending fibres of dissimilar colouring affinities, and of yarn construction and combination; also the principles of fabric weaving as they apply to modern industrialism, for the express object of acquiring an amplified tinted range in the commercial goods. From these technical means and resources—only restricted in variety of textural result by the classes and grades of fibres spinnable and by their colourization value—the trading in costume, dress, and other woven manufactures, has been greatly extended. More especially has this been marked in the manufacture of the following varieties of light fabrics of a plain and figured character—

TABLE II

TEXTURAL VARIETIES—PIECE-TINTED

I.—SINGLE-MAKE FABRICS

(*a*) Textures in mixture-shades, light, medium, and dark in tone.

(*b*) Textures composed of warp and weft yarns contrasting in shade or colour tone.

(*c*) Textures consisting of one shade of warp and two shades of weft.

(*d*) Textures composed of two shades in the warp and crossed with a third shade of weft.

II.—WARP OR WEFT COMPOUND FABRICS

(*a*) Textures formed of two shades of warp and of one shade of weft.

(*b*) Textures formed of three shades of warp and of one shade of weft.

(*c*) Textures formed of two shades of weft and one shade of warp.

(*d*) Textures formed of three shades of weft and of one shade of warp.

III.—COMPOUND WARP AND WEFT FABRICS.

(*a*) Two-ply textures in two shades.

(*b*) Three-ply textures in three shades.

24. *Natural-Coloured and Piece-Dyed Goods.**—It is understood that these several styles of woven textures are, as stated in Scheme X, produced in the natural colour of the materials used in yarn making. Their diversity of shade tone is the consequence of the assortment or percentages of

* See *Union Textile Fabrication*, by the same Author and Publishers.

the filament ingredients of which the warp and weft threads consist, and of the system of dyeing practised. Here it will

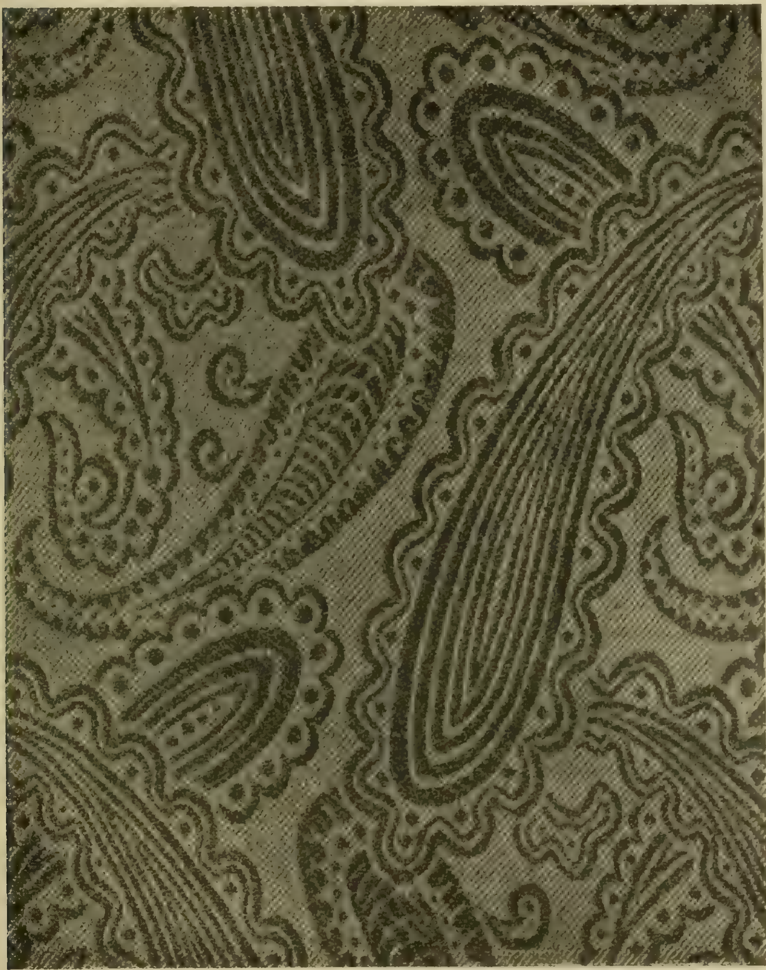


FIG. 20.—BI-FIBRED DRESSING-GOWN PATTERN.

be sufficient to indicate the manufacturing basis and procedure comprised, by alluding to the figured specimens, in Figs. 20 and 21. The former is made of bi-fibred worsted

yarns and the latter of cotton and silk, both fabrics being weavable in the white or grey with the colour composition developed in the routine of piece dyeing.

As a rule in such textures, the principles of design and of fabric weaving adopted are analagous with those obtaining in the manufacture of similar types of cloth in which coloured yarns are admixed in the looming operations. In the first of these examples—illustrative of tone differentiation due to fibre blending—the shades resultant are invariably " mixtures " and not pure or solid colours. One quality of hue necessarily distinguishes each group of shades observed in the dyed piece, so that the changes in shade depth, in any particular style, are strictly gradations in colour tone. They are not the product of diversification in hue or tint. This feature in the mixture tones acquired, in the dyeing of the goods, has to be taken into account in planning and originating the design scheme ; for unless cotton yarns, or yarns which may be differently treated in the piece tinting from the union filament yarns combined in the weaving of the texture, form part of the cloth structure, it is not feasible to separately emphasize any individual sections or details in the pattern. Examining the specimen (Fig. 20), it is producible in two sorts of bi-fibred worsted yarns, namely, a *warp* yarn composed of 60 per cent. of wool and 40 per cent. of cotton, and a *weft* yarn composed of 85 per cent. of wool and 15 per cent. of cotton, and by piece-dyeing the wool fibre a dark colour. The figured parts in the cloth result from the weft, and the ground, or lighter parts, from the warp threads. It is typical of the distinctiveness of line and detail practicable in the production of pattern by this system of colour treatment, and by selecting and applying suitable weave elements. In all instances the figuring, woven in compact floats of weft yarn, is in pronounced contrast with the warp-face twill in the foundation of the texture.

25. *Pattern Development in Cloths of Admixed Yarn Types.*—Combining yarns spun from two or three varieties of fibre as

cotton and silk, cotton, silk and wool, etc., each yarn unit in the cloth may be differently coloured in the piece-dyeing process. This is observed in Fig. 21, a silk and cotton union texture. In the specimen the repp and waved twill features, and the leaf and floral forms, are woven in silk, the dark elements in cotton, and the dulled grey spaces in the two kinds

FIG. 21.—COTTON AND SILK STYLE—PIECE-TINTED.

of yarn worked into a plain rib. With the weave plans of this interesting structure, the design is clearly delineated in the untinted loom fabric, but dyeing the silk one colour and the cotton a second colour, whether in contrasting or complementary hues, adds to the richness and commercial value of this style of manufacture.

The practices in fabric construction, and in coloured-pattern development, exhibited in these examples (Figs. 20 and 21)

are analytically treated of in *Union Textile Fabrication.* The specimens are, therefore, to be viewed here as denoting the systems of manufacturing fancy goods in the natural or untinted material, and of combining the sorts of fibres selected in such proportions, either in yarn formation or in the grouping of warp and weft threads consisting of different kinds of filament, to yield, in piece-dyeing, definite shades or pure coloured results. In the "mixtures," the cloths, as indicated in Scheme X, may be elementary in weave type, or they may be, as shown in reference to Fig. 20, of a figured order ; while the employment of yarns, made of special sorts of fibre, either plain or pattern-decorated textiles are also obtainable with each yarn, in the finished texture (woven in the grey), distinct in tone, tint, or hue, that is, as identical in colour freshness and property as if the yarns applied were hank, top, slubbing, or material dyed and prior to weaving.

26. *Factors Controlling Commercial Stability—Home Trade.*— In reviewing the industrial phenomena and aspects of the dress trade it has been regarded as vital to outline, as far as possible, the textural range covered, the basic and constructive principles in fabric orgination, and the design and colour schemes practised and elaborated.

The commercial aspects of the trade will be noted as they concern the varied conditions and factors which induce and control productive performance and stability. These claim and exact constant thought and investigation on the part of the manufacturer, the designer, and the industrial expert. All trading achievement in textiles is contingent on the nature of supply and demand. Particularly is this a governing principle in dress manufactures, inasmuch as the marketable goods are subjective to insistent and capricious changes in material and style. Textile commerce may, in certain abnormal instances, be created and enforced on exclusive lines. Originative, inventive, and economic work in fabrication is competent of discovering and establishing a new textural basis which may fructuate in this issue. But, in general, business in the dress

industry is measured and determined by conforming with the trend of fashion, especially as this stimulates and sustains the buying interests centred in the markets of Western Europe, the United States of America, and in the Overseas Dominions of Canada, Australia, New Zealand, and South Africa.

27. *Fashion.*—Fashion—prevailing taste in cut and make of garment—forms the pregnant and dominating cause of the quality, shade, material and variety of the textures merchantable. The producer must perforce organize and regulate the mill operations and manufactured output in accordance with its code of teaching. In doing this he finds latitude for the exercise of initiative faculty and ingenuity in cloth type, value, and diversification, providing the resultant manufactures are in consonance with the make-up of the style of garment in vogue. The study of the problem, as it affects progressive industrialism, is facilitated in recognizing that fashion is inspired and substantially formulated by social and economic conditions, and by historic events and conjecture. For example, the modern disposition for tailor-made costumes is largely the consequence of the professional life and career now pursued by women, and in contrast with the domestic sphere favoured by women of a former generation. To wear clothing of unnecessary length and width dimensions is not compatible with the convenient following of the duties in the office, the works laboratory, and the many different métiers in which women have acquired a legitimate place in the professional world. This social transition and advance has left its impress on the trading avenues in textiles for women's wear. Hence the manufacturing proclivities of the last few decades, during which woman's services in the capacities named have been increasingly requisitioned, have gravitated in the direction of the origination of fabrics of the plain and twilled variety. Alpaca and figured textures have been superseded in the home trade by worsted (Botany and Crossbred), tweed (Cheviot and Saxony), and union cloths, similarly

constructed in each case, though lighter in weight per yard, as goods ordinarily adapted for men's consumption.

28. *National Purchasing Power and Factory Production.*—That the purchasing power of the community has a perceptible bearing on the nature and character of the goods fashionable will be evident. How this, in turn, is reflected in manufacturing practice and trading ideals may be traced in the re-organization of the industry, owing to the advance in the labour market, and the betterment of the financial status of the working classes. A decline in the workers' earning capacity is followed by competitive strain in the production of inexpensive manufactures, as the augmentation of this capacity is signalized by the transference of the competitive effort to the making of cloths of a superior material, structure, and quality.

29. *Influence of Economic Evolutions.*—Economic evolutions of this nature impose befitting thought and inquiry. On their judicious interpretation and sound analysis the factory provisions have to be made, and the scheme of trading devised. Their exigencies must be fully met and dealt with. For some years prior to 1914, the market conditions rendered "cheapness," in the manufactured product, a potential factor in maintaining trading constancy, and an absolute requisite to trading aggressiveness and prosperity. In the instance of the workers' wages reaching an unprecedented high standard—as in the present crisis, 1919–20—the trade instincts and activities are levelled as to the classes of goods requisitioned. Pronounced demarcations in the sorts and grades of fabric for the respective sections of society are largely eliminated. The workers are clothed in a similar quality and variety of texture as the middle and upper classes; and, as a consequence, trading, in the bulk, is comparatively of a uniform description, both as to texture and as to the fibrous materials employed.

The problem of what to produce is, therefore, intrinsically suggested in the economic position of the country. This moulds the whole basis and structure of the manufacturing

organization. For this reason it becomes imperative that the dress goods manufacturer should be *au fait* with the purchasing flexibility of the community whose interests he seeks to command. Mutations engendered in this respect, of whatever tendency, should be foreseen and calculated, and the productive operations adapted thereto.

30. *Consolidation of the Home Trade.*—Apart from these considerations, the home trade is capable of being further consolidated by technical research relative to (1) the sources and means of acquiring textural newness; (2) style in the manufactured goods, including design and colour schemes as illustrated and exemplified in historic and modern woven specimens; (3) textile analysis; (4) economic methods of production as distinct from adulterative practices; and (5) in yarn and cloth standardization. The subjects come within the scope of this work, and will be elucidated in their respective connections.

31. "*Style*" *Transitions.*—Regarding "style" it has to be observed that, to the student of modern industrial practice, it is evident that transitions and developments, whether in small or in substantive elements, are incessantly being effected in manufacturing procedure which modify the types of textural production. These may be in the nature of revised and amplified phases of well-known systems of work, or they may consist of styles emanating from experiment and investigation. Trading success and growth are recognized as being closely allied with, and dependent upon, the amount of technical ingenuity thus directed and exerted. This factor vitalizes mill productiveness, and determines the successive degrees of progress in the textile arts as associated with dress-fabric manufacture.

A study and an analytical survey of the styles and classes of fabrication, season by season, may not palpably reveal the process of reconstruction taking place. Extending the period of comparison to ten or twenty years discovers, however, its active efficiency. Important and radical changes are now

observed as a direct result of sustained and successful effort in the origination of fresh varieties of loomwork. All advance in textile constructiveness is relative. It is not a spontaneous but an evolutionary growth. Distinctive achievement in the dress as in other branches of trade is rooted in historic venture and performance. Experimental speculation in manufacture and design is, therefore, strengthened in compass by embodying what has been accomplished, as it is enriched in issue by expanding and supplementing the work already wrought. The technical co-efficients of commercial aptitude obtain, in a pre-eminent degree, in a comprehensive knowledge of "style" as defining the texture, design, and colour composition of the manufactures in vogue at different periods of the trade.

32. *Standardization in the Dress Industry.*—Hitherto the principle of production to "standard" has not been appreciated to its full value, as a cause of business success, in the spinning and weaving branches of the dress industry. Standardization in yarn and fabric, and also in dyeing and finishing, in the bulk groups of dress and costume cloths, should be instituted as a means of increased industrial efficiency, and as an auxiliary to trading practice and conservation.

Experience and precedent have been largely the accepted rule and guide in the acquirement of a requisite quality of yarn and texture. But it must be obvious that accuracy in, and uniformity of, manufactured result, are to be more satisfactorily attained when an organized system of testing the process products is adopted. The features and properties of the finished fabric are contingent on the correctness of each series of operations through which the material passes. They are not solely the organic derivatives of specified counts of yarn made of cotton, wool, silk, etc., woven into cloths of a prearranged thread compactness or density. Other and more subtle elements enter into the scheme of work, and assist in determining and fixing the actual grade of texture produced. Material preparation in carding and combing, in drawing or condensing, the degree of twine inserted in spinning, and the

filament grouping and admixture in the spun yarn, all exert controlling effects on the fineness, softness, elasticity, wearing durability, and tensile strength of the woven product.

The inference is that something more is needed than the checking and passing of the departmental output of goods, as at present done. Technical testing, comparative analysis, or laboratory investigations of the products should be undertaken and carried out in the factory. The equipment and province of the laboratory would be ordered and adapted to the class and variety of the materials used, the assortment of yarns spun, and the styles of fabrics made. In the case of a spinning mill, the apparatus would be such as to enable qualitative and quantitative chemical analyses to be prosecuted in the raw and manufactured ingredients employed; microscopic examination of the process results; and the testing of the yarns for fibre composition, twine, breaking strain, and elasticity. But each factory would find it convenient to add to the organization, adjusting the system of investigation to its special productions and trading requirements. Naturally, in the case of factories, including the whole scheme of manufacture, equipment would be provided for covering the mechanical, chemical, comparative and identification tests of the fabric as well as of the yarn and the fibrous material; and also of the degree of permanence and tone purity of the dyed colour, and the textural conditions and qualities due to the finishing routine. Standardization on this basis, in the dress trade, presupposes an important extension of mill procedure and methods, but it aims at a measure of industrial efficiency culminating in definite and consistent forms of textile commerce.

33. *Shipping or Foreign Trade—Divisible into Two Sections.*—The Shipping or Foreign trade in dress goods is divisible, in regard to styles and descriptions of manufacture, into two principal sections. First, trade with the countries of Western Europe (France, Italy, Belgium, Germany, Spain, Portugal, and the Netherlands), the United States of America, and the

Overseas Dominions of the British Empire, exclusive of India. Second, trade with the countries of the Near and Far East (Russia, Persia, Turkey, India, China, and Japan) and of South America, more especially the Argentine Republic, Brazil, Peru and Chili.

34. *Prestige of the French Fashions and the Goods in Demand.*—For the former section, the goods are mainly of a similar order and classification to those produced for the Home Trade, and which are saleable in the markets of the United Kingdom. Distinctions in colouring and in texture are, however, introduced in the instance of manufactures intended for Italian and Spanish consumption. Generally, in communities in which the French fashions in dress are observed or followed, the goods purchased are of a like material consistency and fabric variety; but, in exploiting continental markets, the social and economic aspects and conditions, explained as influencing trading returns, have to be taken into account.

35. *Phenomena Affecting Trade in the Near and Far Eastern Countries.*—Further, in the second category of the shipping trade, attention has to be given, by the home producer, to the following characteristic features and phenomena in the countries concerned: (1) Climatic conditions; (2) National customs in dress; (3) Native predilections as manifest in the demand for textures of materials, designs, and colourings possessing a symbolical or emblematical significance; (4) Religious, caste, and social prejudices; and (5) Economic cost of the manufactures, especially in rivalry with goods made by competitive communities, e.g. France, Germany or America; and as consistent with the purchasing power of the people.

36. *Board of Trade Intelligence and Foreign Trading.*—The subject of this branch of the foreign dress trade is linked up with intelligence bearing on these heads. Under informed and primed conditions technical power may be exerted in achieving the prescribed industrial and commercial task. If the maker should be imperfectly apprised of the specific requirements of a trading centre, he labours at a disadvantage, and his

productions are as likely as not to be unsuitable in material, quality, style and price. Exact and trustworthy commercial intelligence is the security of successful modern dress manufacture.

Markets may be nurtured and exploited by gleaning and assorting data and information on different spheres of foreign commerce. A more complete intelligence system, authoritatively planned and operated, is fundamental to the commercial and manufacturing interests of the dress goods industry. To know the nature and scope of a trading requisition is, in business warfare, more than half the battle to a resourceful producing community. Hitherto the fertility of the British industrial supply has exacted recognition and ensured progressive development. If the precise form of product were absent, a passable substitute was possible. Between the two lies the realism in manufactured adaptability and fitness, and this provides the true or preferential marketable value. Faculty in constructiveness is not to be lessened but augmented by the advantages in manufacturing practice accruing from penetrative and inclusive commercial information. The maker, possessing a solid basis on which to establish inventive work, is enabled to originate mercantile goods diversified in structure, design, and application, and in close agreement with the special needs and technicalities of the markets for which they are intended.

It should be reiterated that in cultivating Eastern and South American trading in dress materials, with a view to its constituting the staple business of the factory, the producer should have recourse to both private and official sources of intelligence. To rely upon the former is not an adequate procedure. Isolated and spasmodic effort such as it embodies is not to be pitted against systematized inquiry and administrative action. In the latter, the objects and functions of the Commercial Intelligence Department of the Board of Trade grip the industrial problem. They embrace the collecting, co-ordination and presentation of informative records on the trade, industries,

and shipping of the countries affected. The plan formulated has the intention, firstly, "to enable the Government to form a correct appreciation of the commercial relations between the British Empire and the several foreign countries from the point of view of British commercial interests"; secondly, "to facilitate the efforts of the British traders to get into touch with the mercantile and industrial communities in foreign countries, as well as with the national or local authorities where necessary"; thirdly, "to enable the Government to promote, and if necessary assist in negotiating through its agents abroad, commercial or industrial concessions to British subjects, where such concessions are of sufficient importance to call for Government intervention"; and, fourthly, "to afford, within the limits of diplomatic or consular action, assistance in composing or smoothing over any difficulties that may arise beteeen British subjects in the exercise of their trade or legitimate commercial activity, and foreign Government and local authorities." Under the first category there is also the important issue of the British Government being in a position "to afford advice on matters arising in connection with the negotiation of commercial treaties, based on a comprehensive knowledge of the commercial geography, legislation, and actual conditions of the foregin countries concerned"; and "to furnish to the British traders reliable information as to (*a*) local laws, rules, regulations, and trade customs; (*b*) existing or potential markets for British exports; (*c*) supplies needed by, or useful to, British industries which are or may be produced in the countries concerned; (*d*) openings for British capital in developing the natural resources and general prosperity of such countries; and (*e*) suitable agents for British firms in foreign countries.

This informative force should be serviceable in conserving, directing, and advancing British textile industry and commerce. It opens up trading facilities and avenues of great potentiality to the English manufacturer. Prepared instead of unprepared trading ground is to be available for industrial

developments. In the commercial exploration of a foreign country, accumulative intelligence, useful to the home producer, may either precede or be carried on side by side with trading activity, evolving conditions influential in enforcing and sustaining industrial continuity and progression.

37. *Provisions Relative to Trade Intelligence and Dress-Fabric Manufacture.*—Specifying the provisions of direct import and significance to the dress-fabric manufacturer interested in the shipping trade, they should also comprise—

1. Intelligence affecting commerce in manufactured goods, as it may be rendered instrumental in the successful exploitation of foreign markets, that is, suggestive to the producer as to the materials, textures, and styles of design adapted to national usages, dress, manners, and customs.

2. General intelligence concerning the textile industrial status of a country as included in and determined by (*a*) the indigenous and imported supplies of the raw materials of manufacture; (*b*) the existing and prospective character of the local industries; (*c*) labour efficiency and the educational and official organization employed for its betterment; (*d*) the branches of industry and commerce on which the activities of the country are mainly concentrated; and (*e*) the initiative and enterprise shown in native manufacture, and the facilities existing accessory to their realization.

The more complete and the more searching the study and dissection of these problems, connected with foreign trading in all classes of fabrics for women's wear and apparel, the fuller the enlightenment of the British producer on the exact needs of the shipping markets, and the stronger the state of preparedness of British industrialism for assuming the province of furnishing the requisite manufactured supplies.

38. *British Industrial Centres.*—The dress goods trade of the United Kingdom is chiefly located in the Bradford and Keighley districts of the West Riding of Yorkshire, the South-Eastern towns of Lancashire, and in Glasgow and the vicinity. The

woollen branches, as represented in tweeds and costume cloths, made of all-wool yarns, are practised in the Border towns of Scotland, in the north, west, and south of Ireland, in Huddersfield and the neighbourhood, with fine-faced goods of the habit cloth quality in the West of England, and textures of a flannel character in Rochdale. Raw silk and artificial silk manufactures are extensively produced in Macclesfield, Coventry, and Spitalfields. Union silk textures are a staple section of the industry in Bradford, Keighley and Glasgow, but the raw silk goods are largely from the looms of Macclesfield, and the more decorative varieties from the looms of Spitalfields. Linen cloths form a comparatively smaller section of the trade. They are chiefly of Irish manufacture and from the factories of Belfast and Lurgan, with limited contributions from the mills of Dundee and Dunfermline. Knitted or hosiery woollen and worsted textures are made in Leicester, Hawick, and Edinburgh, and knitted artificial silks in Macclesfield and Leek. Embroidered fabrics, of different yarn ingredients and looming structures, are pattern decorated on the embroidery frames of Nottingham, smaller design effects being hand-sprigged or machine-worked by the cottagers in certain Irish localities.

Bradford is the historic centre of the trade in lustre stuff goods, and includes Shipley, Saltaire, and Bingley. Keighley, with Silsden, Cowling, Skipton, etc., also occupies a prominent place in the same classes of manufacturing. Both the Bradford and Keighley centres specialize on, first, the lighter makes of fabric—Sicilians, brilliantines, linings, figured lustres, gabardines, and the several sorts of alpaca, mohair, and camel-hair textures—and, second, on the medium weights of plain and fancy worsted and union costume cloths. Velvet, pile, and plush goods are also an important class of the productions of the Bradford mills.

Glasgow is the principal centre of the dress fabric industry in Scotland. While its trade output does not include "lustres" it combines a large assortment of thin and light fancies, such

as skirting, blouse, gauze, and lappet textures as producible in heddle-mounted and Jacquard looms.

The Lancashire districts naturally concentrate on cloths made of cotton yarns—the plainer and lighter varieties (voiles, muslins, and zephyrs) being made in Burnley, Heywood, Nelson, etc., lappet and gauze fabrics in Preston and Bolton; striped and checked goods in Blackburn; velveteens, corduroys, and velours in Hebden Bridge, Todmorden, and Sowerby Bridge (Yorkshire); and general and diversified sorts of manufacture in Manchester, Pemberton, Chorley, Bury, etc. The cotton trade is complex in organization, hence in the same mill voiles on 2-fold 100's or 2-fold 150's warp and weft, and heavy flannelettes and creton cloths composed of 32's twist warp and 8's twist weft may be produced.

The outstanding features of the trade, as here delineated, are the large and progressive industrial areas covered, the varied systems of manufacture fostered and practised, the technological interests involved, and the diversity of textural product acquired for both home and foreign consumption.

CHAPTER II

THE YARN UNIT

39. *Yarn a Controlling Factor in Fabric Design.*—It has been indicated that the Yarn Unit is a primary and constant source of textural diversification in the manufacture of dress goods. The importance of a full and accurate knowledge of the different kinds of yarn, with a technical appreciation of their structural qualities and characteristics, needs to be strongly emphasized. Modern practice recognizes the significance of the yarn product in a number of ways, and the competent designer proceeds on the basic understanding that to obtain an adequate measure of commercial success the scheme of fabric building starts with the fibre, takes cognizance of thread construction, enters into the loom-made texture, and covers the processes of cloth finishing.

In fabric structure and in design planning, the yarn employed is regarded as a controlling factor. On its apt selection, as to its material ingredients, counts or fineness and mechanical formation, the fitness of the texture for the purpose intended,

and the effective development of the pattern details, are mainly dependent.

40. *Yarn Features relative to Textural Utility.*—Yarn in this relation presents four distinctive features, each of which modifies its textural functions and applications, namely, (*a*) Filament composition; (*b*) Diameter measurement or thickness; (*c*) Structure as determined by the method of manufacture; and (*d*) Weavable form, that is, whether a single spun thread or consisting of two or several spun threads folded into one yarn unit. In the dress trade, as pointed out in the early sections of Chapter I, every variety and description of textile fibre may be utilized. The goods may result from cotton, flax, silk, wool, hair, or wool substitutes; or they may be admixtures of two or more classes of fibre. From this it is to be understood that whichever sort of material is applied, it is designed to impart its properties—whether natural or artificially developed—to the manufactured cloth. As this is a fundamental principle in all branches of textile production, it will be explained in reference to dress textures by considering the yarn groups obtainable from each variety of staple, and the qualities and grades of woven fabric acquired in each kind of yarn.

41. *Cotton Yarns and Cloth Qualities.*—The textures resulting from the use of cotton yarns are normally clear in surface features, with the threads distinct, and the weave and pattern satisfactorily delineated. Compared with woollen and worsted fabrics they are somewhat deficient in softness of feel, but possess firmness and durability of structure.

Under certain conditions the yarn properties, as derived from the raw material, are subjective to modification in the manufactured goods. Thus, by the process of mercerizing, the natural flat tone of the cotton fibre is changed to a bright tone, causing the yarns so treated to give to the fabric a degree of the lustre seen in silks. Second, cotton-yarn cloths of the sateen type may be lustred in the work of dressing and finishing; and, third, the thicker or heavier builds of cotton fabrics, composed

of loosely-spun yarns, may be raised and covered with a nap of filament, imparting some of the fullness of handle which is known to distinguish woollen cloths. But, ordinarily, the cotton yarns, being compact and dense in fibre, and the fibre being small in diameter, are applied to textures firm in construction, smart and clean on the surface, and well defined in warp and weft intersections. This is equally characteristic of the plain as of the fancy woven fabrics. It also distinguishes figured cotton goods, and cottons of the gauze and lappet structure. In velveteens, corduroys, and ribbed-velvet cotton manufactures, as in cloths of the velour (raised pile) description a specific aspect of the pile, as contrasted with that in similar styles of fabrics obtained in silk, mohair, or worsted yarns, is dullness of colour tone. The even, smooth, and symmetrical formation of cotton yarns, and the range of counts in which the yarns are spun, render them applicable, as warp, weft, or as both warp and weft, to an extensive assortment of dress and blouse fabrics in light and medium weights.

42. *Linen Yarns and Textural Features.*—With linen yarns, somewhat brighter and better delineated textural features are producible than in cotton yarns. The linen fabric has, however, a peculiar hardness of feel, which, in comparison with a cotton cloth of the same yarn setting, is suggestive of a deficiency in thread flexibility and pliancy. Clearness and smartness of woven surface, with the interlacing details forcibly developed, are readily acquired in the use of such yarns. Yet linen yarns are not so generally well adapted for dress manufactures as yarns made of cotton. In the finer counts, they are employed in the construction of thin, light textures, either plain, leno or gauze woven ; and, in the medium and thicker counts, of the looser spun grade, in the weaving of goods of the canvas cloth variety. Further, in admixture with cotton, linen threads yield a special class of union fabrics, in which cotton forms the material of the warp yarn, and flax the material of the weft yarn. Linen textures are of great

durability, and recover their original freshness of tone in cleansing and pressing. The relative higher cost of flax than cotton, plus the increased attention required in loom production in the use of linen as compared with cotton warp yarn, detracts in a measure from the wider applicability of linen yarns in the making of dress goods. Linen, however, is preferably used in the surgical and medical profession on account of its clean, smooth quality, and also on account of the firm, compact thread it produces, and the readiness with which the fabric absorbs moisture.

43. *The Silk Yarn Units.*—Silk and artificial silk are so largely used in dress fabrication, and have such a special technical interest and value, that they are separately dealt with in Chapter III. Here it may be observed that neither material is prepared and formed into a thread by the systems applied in the treatment of cotton, flax, ramie, jute, wool, and hair. The first is in a matured thread-like state in the cocoon and is converted into a yarn of weavable consistency by "throwing," "reeling," and "doubling"; and the second is manufactured chemically from wood pulp. "Spun" silk is the waste fibre derived from the reeling of damaged cocoons. By reducing such "waste" to a flossy material it is rendered suitable for a similar mechanical treatment—opening, drawing, and twisting—akin to spinning routine as commonly understood. Both Silk—raw and spun—and the artificial or chemically-produced silk substitute, are employed in fabrics composed of cotton warp to a large degree, and of worsted warp to a lesser degree, for imparting richness of textural tone and colour brilliancy. Silk is, moreover, used in the origination of numerous varieties of dress and blouse cloths, as well as important styles of figured goods, which will come under analysis. Added to these intrinsic textural values, silk yarns are obtainable in a fineness of diameter and of tensile property not practicable in other sorts of fibre; while the pure silk fabric is remarkable for its durability in the made-up garment.

44. *Yarns Made of Animal Fibre.*—These yarns, as

they concern the dress industry, are divisible into yarns made of wool (worsted and woollen), alpaca, mohair, cashmere, camelhair and vicuna fibre. Of the yarns acquired from wool, and from wool admixed with vegetable fibre (cotton, ramie and flax, but mainly cotton), there are two principal varieties, namely, yarns prepared and spun on the worsted, or combed-and-drawn, system ; and yarns prepared on the woollen, or carded, and condensed system. The worsted and woollen practices of preparation include the yarn process and yarn types described in Table III.

TABLE III

WORSTED YARNS MANUFACTURED OF ANIMAL FIBRE

I.—Yarns manufactured on the English system and comprising—

(*a*) Botany and Crossbred Yarns—carded, combed, drawn, and *frame* spun.

(*b*) Lustre-wool Yarns—Gilled, combed, drawn, and *frame* spun.

(*c*) Alpaca, Mohair, Cashmere, and Camelhair Yarns—Gilled, combed, drawn and *frame* spun.

II.—Yarns manufactured on the French System and comprising—

(*a*) Botany and Crossbred Yarns—Carded, combed, drawn, and *self-actor* spun.

(*b*) Bi-fibred or Union Worsted Yarns—Carded, combed, drawn, and *self-actor* spun.

WOOLLEN YARNS MANUFACTURED OF ANIMAL FIBRE

(*a*) Saxony Yarns, spun from fine and short-stapled wools.

(*b*) Cheviot Yarns, spun from medium-stapled wools.

(*c*) Vigogne or Union Yarns, made of wool and cotton.

(*d*) Inferior grades of Saxony, composed of wool and wool substitutes.

(*e*) Inferior grades of Cheviot, composed of strong wools and shoddy, or of the longer-stapled materials reclaimed from cast-off garments and fabrics which have been in use, whether consisting solely or partially of animal fibre.*

45. *Worsted and Woollen Groups of Yarn.*—Both the worsted and the woollen groups of yarn vary considerably in the counts or thicknesses in which they are applicable to the dress industry, such as, in the former, from 2-fold 20's (= 10 hanks per lb., i.e. 2 fold 60's = 60 hanks of 560 yards each per lb.) ;

* See *Wool Substitutes.*

and, in the latter, from 16 to 24 yards per dram. Worsted threads of the smaller and medium diameters are used in the thinner and lighter classes of goods either made of pure wool or animal fibre, in both the warp and weft yarns, or with the warp yarn made of cotton or flax and crossed with a yarn of the worsted structure. Worsted threads of the heavier counts enter largely into the manufacture of solid worsted costume cloths. Woollen threads of the finer counts are adapted to the production of all-wool fabrics having a fibrous or face finish as in the "habit" cloth type; those of the medium counts to union textures of a flannel character; and the thicker woollen yarns to fancy tweeds of a costume weight.

46. *Wool Fibre and Thread Formation.*—From wool the fullest range of yarn counts is derived. The fibre is wavy, flexible, and soft, with the external scales more or less lustrous. The staple, or natural length of filament, in the "short" wools, averages from a fraction to over 2 inches in length; in the "medium" wools from 3 to 5 or 6 inches, and in the "long" wools from under 7 to 16 or more inches. Chemically, the analysis of the fibre is identical in each class of staple, but the variations in filament fineness, elasticity, and measurement, provide an extensible spinning compass. The two systems of work indicated form the two ideals in thread preparation and construction. The worsted system develops the lustrous character of the wool in combination with the acquirement of a smooth, level thread; and the woollen system develops the flexible property of the wool in combination with the production of a yarn having a comparatively non-lustrous surface, and one in which the fibres are freely commingled and intercrossed.

Whenever, in dress manufacture, it is sought to emphasize the lustre value of the material in the commercial fabric, the yarns selected are spun on the worsted practice. To acquire this value with yarns of the woollen nature involves raising the surface of the cloth, or the bringing of the fibres into a coincident relation as obtains in worsted thread construction.

Parallelism of filament in the texture, right or under side, lends brightness of tone to the woven manufacture, in so far as it is producible from the class of wool used. On the other hand, fullness and depth of tinted tone coincide with the tips of the fibres being exposed to the light, as in the instance of the crossed and intertwined grouping of the fibres in the woollen thread; and also in a milled and raised cloths in which the ends of the fibres rather than their lateral sides are presented to view

Softness, warmth of feel, and comfort in the wear, are the characteristic features derivable from the employment of yarns made of wool in whatever structural form they are applied in the weaving process. Whether the staple is short, medium, or long, the fibre coarse or small in diameter, or the wool spun into a combed or carded thread, the textural product should possess these qualities in a pronounced degree.

It is not, however, to be understood that the yarn, and the texture manufactured, do not differentiate in value and in technical and trading applications with the sort and grade of wool selected. With wool, and also with other varieties of textile fibre, the yarn features and yarn utility are modified with the nature and fineness of the filament, and with the length and elasticity of the staple. Thus the shorter-grown wools yield the Botany and Saxony kinds of yarn, the medium-grown wools the Crossbreed and the Cheviot, and the long-grown wools the Lustre kind of worsted yarn. Into the uses of the different categories and qualities of wool it is not necessary to enter here.* But the structural form and special weaving properties of each description of yarn require to be taken into full consideration. Each type of thread is a unit in fabric production, so that its standardized applications in manufacturing practice need to be explained. The industrial designations of the respective classes of yarn, and the approximate range of counts in which they are used commercially are given in Table IV.

* See Chapter I. *Woollen and Worsted.*

TABLE IV

COMMERCIAL YARN COUNTS—WOOL AND HAIR

(*See Specimens in Fig.* 22)

	Description.	*Range of Counts in 2-fold Yarns.*
A	Botany Worsted (English prepared and spun)	2/16's to 2/180's
A^2	,, ,, (French prepared and spun)	,, ,,
B	Crossbred Worsted (English prepared and spun)	2/8's to 2/32's
B^2	,, ,, (French prepared and spun)	,, ,,
C	Lustre Worsted	2/12's to 2/40's
D	Cashmere	2/12's to 2/32's
E	Alpaca	2/12's to 2/50's
F	Mohair	2/12's to 2/50's or 2/60's
G	Camelhair	2/8's to 2/40's
H	Saxony Woollen	2/10 skeins to 2/44 skeins
I	Cheviot	2/8 ,, 2/28 ,,
		Range of Counts in Single Yarns.
A^1	Botany Worsted (English prepared and spun)	10's to 80's
A^3	,, ,, (French prepared and spun)	,, ,
B^1	Crossbred Worsted (English prepared and spun)	8's to 32's
B^3	,, ,, (French prepared and spun)	,, ,,
C^1	Lustre Worsted	12's to 40's
D^1	Cashmere	12's to 32's
E^1	Alpaca	12's to 50's
F^1	Mohair	12's to 50's
G^1	Camelhair	8's to 40's
H^1	Saxony Woollen	5 skeins to 40 skeins
I^1	Cheviot ,,	3 ,, 24 ,,

47. *Yarn Specimens Compared.*—All these yarns differ in character and in textural application ; yet the yarns A to G, in both the 2-fold and single counts, are of the worsted structure, with the fibres similarly straightened, levelled, and lined with each other in the making of the thread. The structural distinctions are principally due to the varieties of material used in their manufacture ; and, in a secondary sense, to the necessary differentiations in the mechanical treatment incident upon the working of materials of dissimilar staple measurement into a yarn-like form and condition. In the instance of A and A^2, B and B^2, A^1 and A^3, and B^1 and B^3, the distinctions are also caused by the practice of two systems of drawing and spinning. First, it should be noted that threads A, A^1, A^2,

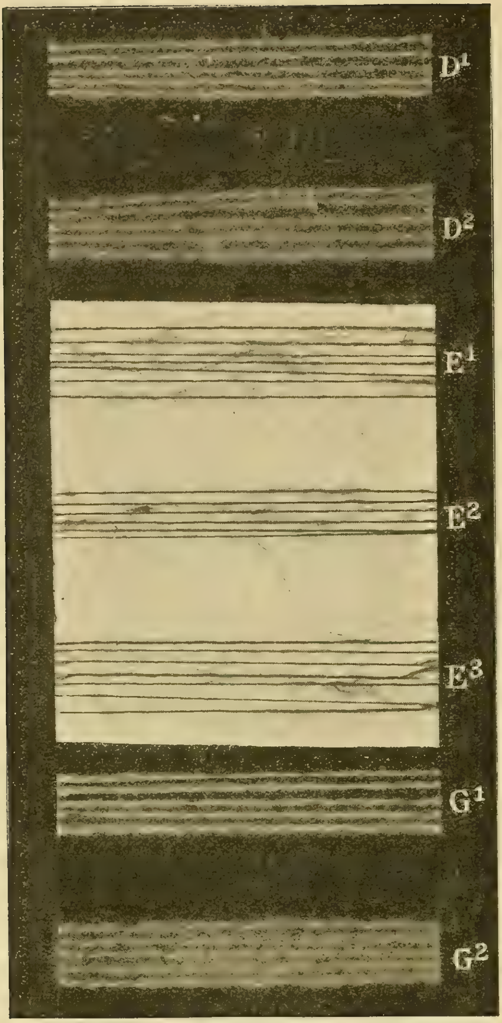


FIG. 22.

D^1 = 2/16's Cashmere.
D^2 = 2/16's Cashmere and Wool.
E^1 = 28's Alpaca.
E^2 = 32's Alpaca.
E^3 = 36's Alpaca.
G^1 = 2/16's Camelhair.
G^2 = 2/16's Camelhair and Wool.

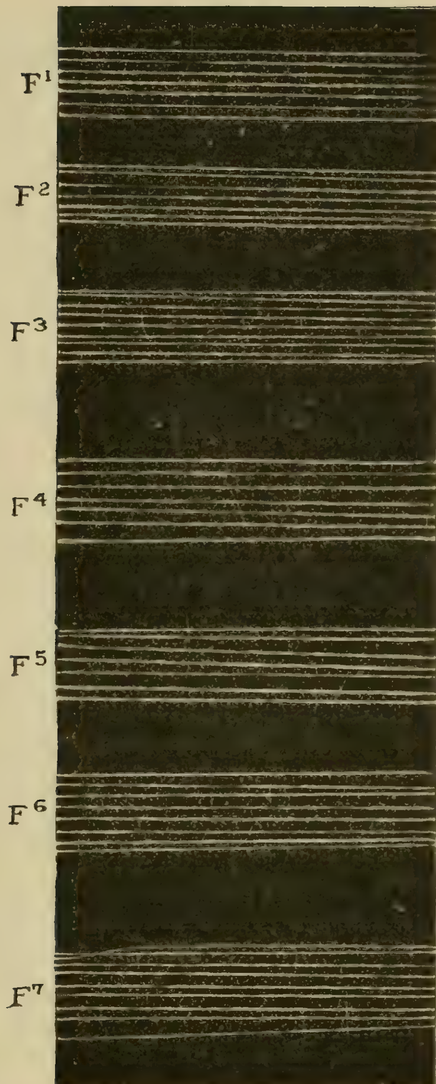


FIG. 22.

F^1 = 2/32's super Mohair.
F^2 = 2/40's ,, ,,
F^3 = 2/50's ,, ,,
F^4 = 1/16's Super Mohair.
F^5 = 1/24's ,, ,,
F^6 = 1/30's ,, ,,
F^7 = 1/36's Super Mohair.

and A^3 are denser and more compact in fibre than threads B, B^1, B^2, and B^3. This fundamental distinction between the two typical worsted threads arises from the finer and shorter wools employed in spinning Botany as compared with Crossbred yarns. The latter thread is of the opener and stronger character and results in fabrics of a brighter tone than the former. Botany cloths are, however, the softer, the more supple and the more pliable, while the Crossbred-yarn cloths possess the greater crispness or sharpness of handle. It follows that textural quality, as determined by fineness of fibre, is obtainable to a superior degree in the Botany yarn, and textural quality, as determined by brightness of surface and keen firmness of feel, is the more effectively developed in yarns of the Crossbred variety.

48. *English and French Worsted Yarns.*—Apart from these features—the results of the kinds of wool selected for the manufacture of the respective yarns—the types of thread specified at A and A^1 or A^2 and A^3 differ in structural formation. The English-made worsted, Botany or Crossbred, is the clearer in tone and presents the more level and smoother surface, while the French-made worsted, from the same class of wool and spun to identical counts, possesses the greater suppleness and flexibility of structure—that is a thread of a more yielding filament consistency. One yarn may be designated a comparatively "lean," and the other yarn a comparatively "foody" worsted thread as regards fibre composition and fibre grouping and arrangement. These distinctive characteristics originate in the methods of drawing and spinning. The combed slubbings, on the English practice, receive, at each operation in the drawing sequence, a quota of false twist, and a percentage of oil, and the yarn is *frame* spun; whereas, in the French practice, the combed slubbings pass down the drawing in a perfectly open and dry state, and the yarn is finally spun on the *self-actor*, but "roller" and not "spindle" drafted as in the making of woollen yarn. These structural distinctions, in the two grades of worsted thread,

will be shown to have a bearing on the purposes to which the respective yarns are applied in dress fabrication.

49. *Value of Filament Length.*—When the yarns defined as lustre worsted, cashmere, alpaca, mohair, and camelhair—C to G in Table IV and specimens D^1, to G^2 in Fig. 22—are examined, it is found that staple length and filament structure have a dominant effect on the quality of all classes of "lustre" yarns.

Each fibrous material here represented is of the long-stapled variety. In preparing fibres of a pronounced length into yarn, however small the yarn may be in circumference, the fibres freely overlap each other in a lineal direction, and for a fractional length of the thread corresponding with their average measurement. Therefore, the longer the individual fibres in the staple, when such are mechanically levelled and attenuated to their normal stretch, the smaller the number of filament units in a given counts of yarn, but the more extended the side by side relation of fibre with fibre in the thread. Taking, for example, two materials of the same net filament fineness, say, merino combing wool and cashmere, the first of 2 in. to $2\frac{1}{2}$ in. and the second of 5 in. to 6 in. in staple, and spinning each to 30's counts (diameter $\frac{1}{116}$ of an inch) the percentage of fibre in the worsted yarn, length for length, would be much higher than in the cashmere. A dissection, however, of cross sections of the different yarns would show the aggregate number of the fibres in each to be in approximate agreement. Comparative shortness of staple, in the wool, accounts for the relative increased quantity of filament in the Botany as contrasted with the cashmere yarn when examined inch by inch; and identical filament fineness, in the wool as in the cashmere staple, accounts for the ratio of fibres being in conformity, one thread with the other under a cross section analysis. Hence fineness, and not length, of filament determines the number of fibres in a specified yarn diameter; while length, rather than fineness, results in the yarn being filament marked and characterized.

50. *Staple Measurement and Yarn Structure.*—Staple measurement as a co-efficient in yarn structure may be graphically illustrated. To refer to Fig. 23, section A is suggestive of the fibre classification and grouping in yarns consisting of short-stapled, and section B of long-stapled, material. The more extended overlapping of fibre with fibre is at once observed in A as compared with B. The larger number of individual fibres required in A to form one or several inches of yarn—increasing with the amount of disparity between the average lengths of the two classes of filament represented—is also clearly brought out. Another feature is suggested, that of

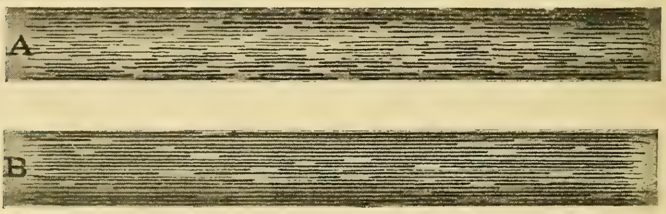


FIG. 23.

the influence of fibre length in imparting character, as indicated above, to the spun thread. In the shorter stapled material, the fibres in the aggregate, rather than as separate units, modify and fashion the yarn quality and structure. Thus, in threads made of fine merino wool the fibres in the mass yield the structural yarn value, each filament being less distinctive in the thread formation than in yarns made of lustre wool or long-stapled material. In the latter, the extent to which each fibre runs through the thread induces conditions which accentuate the physical properties and structure of the filament, so that the fibrous factor is rendered increasingly assertive in giving definition to the tone and constructive type of the yarn.

51. *Lustre Quality in Cashmere, Alpaca, Mohair, and Camel-hair.*—When these data are associated with the distinctive surface elements of the longer varieties of animal fibre, they

augment in value as they affect the nature and quality of the spun thread. In alpaca, cashmere, mohair, and camelhair (*see* specimens in Fig. 22), and also in the lustre wool, the outer scales are of the larger dimensions, but symmetrical in order of grouping from the root to the tip of the fibre. The scales in the wool filament—merino, crossbred, and lustre—tend to protrude slightly from the core outwards, but in other animal fibres they lay flatter or closer to the surface, which adds to the smoothness of the hair or filament. In other words, the serrations forming the external portion of alpaca, cashmere, and mohair are of that evenness of disposition as to reflect the light freely, or to develop the natural brightness of the staple. The true, straight formation of such fibres also contributes to the development of this quality. The staple of the materials may be wavy, or it may be composed of spiral locks, but the individual fibres are less undulated, or crimpy in appearance, than the fibres in the staple of merino or crossbred wools.

52. *Yarn Differentiations.*—The manufacture of yarns in the long-stapled materials on the worsted principle, with the filaments correctly aligned, has the effect of exhibiting the lustrous tone of the materials, and also of utilizing their maximum staple length in producing a smooth, even thread structure. Further, considering the several classes of yarn tabulated, and in the light of these deductions, it will now be understood how yarns spun to the same counts, and by similar mechanical routine, actually vary in technical features and in manufacturing attributes. First, the more open structure of Crossbred as contrasted with Botany yarns, is obviously caused by the relatively stronger and thicker fibres of which the Crossbred yarn is composed. Second, in regard to the cashmere and alpaca yarns (D^1, D^2, E^1 and E^2 in Fig. 22) they might be formed of fibres of an average fineness as the Botany worsted but of a greater staple length, resulting in the comparatively "thinner" and "leaner" quality of these threads. Smallness of fibre diameter, in both the cashmere and the alpaca, is the origin

of the softness and suppleness of such yarns, which, in the better qualities, are also distinguished by silkiness of feel. Third, the lustre worsted and mohair are both bright in tone but of a less flexible filament composition than cashmere or alpaca; with the mohair, if spun from selected sorts, of an exceptional lustre and colour purity.

53. *Circumferential Area of Yarns.*—It should be observed that the disparity in the circumferential area of the different varieties of yarn, when spun to identical counts, is more apparent than actual. Lustre threads of the same counts as Botany yarns appear to differ in thickness or diameter. This technicality requires explanation. Lustre yarns are particularly suggestive of the influence of filament qualities—fineness, tensility, and length—in the working or weavable circumference of the thread produced. Yarns may be firm, hard, or loose and pliable, or even spongy in fibre composition. As the yarn structure leans to one or the other of these extremes, it assumes, or relapses from, its true mathematical proportions.

The fullest measure of filament consistency and cohesion is observed in the English and French Botany yarns. Compactness of structure in these yarns is not a consequence of excessive twisting. This is absent from all Botany yarns which are normal spun, or from yarns in which the turns per inch are consistent with the staple length and the yarn thickness. Yet, as pointed out, there are discrepancies in structural details which modify the perceptible diameter of the different kinds of yarn made of animal fibre. It has to be taken into account that, as the staple length increases, the average filament stretch in the thread becomes greater, and this is followed by a proportionate diminution in the aggregate number of fibres in a transverse section of a known counts of yarn. This implies that the greater the length of the fibres combined in making the yarn, the less, as a common rule, the twine insertion in the process of spinning to form a weavable thread, and the more favourable the yarn structure acquired to the dispersive,

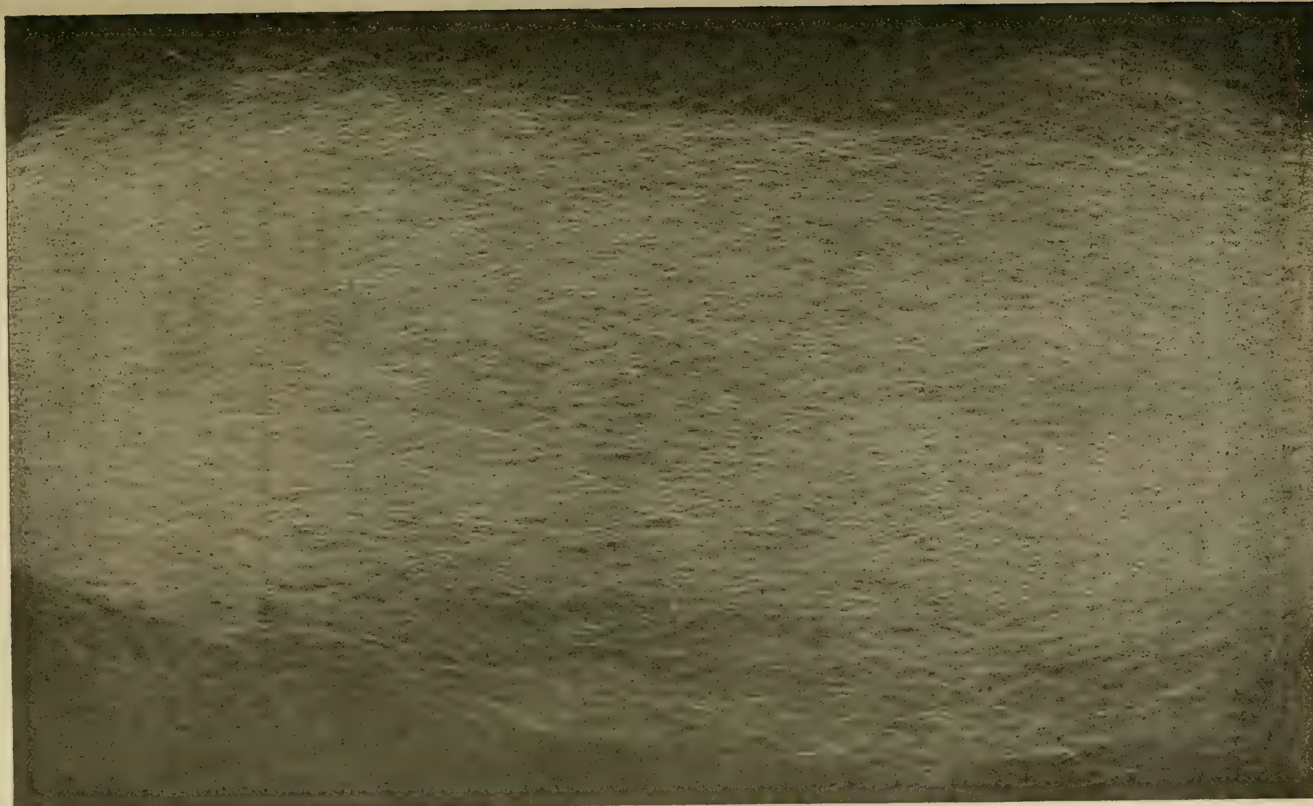


Fig. 24.—Sample of Combed Top.

spreading, and diffusive properties of the materials used. By such filament conditions the superficial area of the thread is visibly enlarged, and this exaggerates its working or textural setting diameter, and also affects the properties it originates in the fabric.

54. *Woollen-Yarn Structure.*—Woollen yarns are typical of the spun thread structure in which the maximum filament

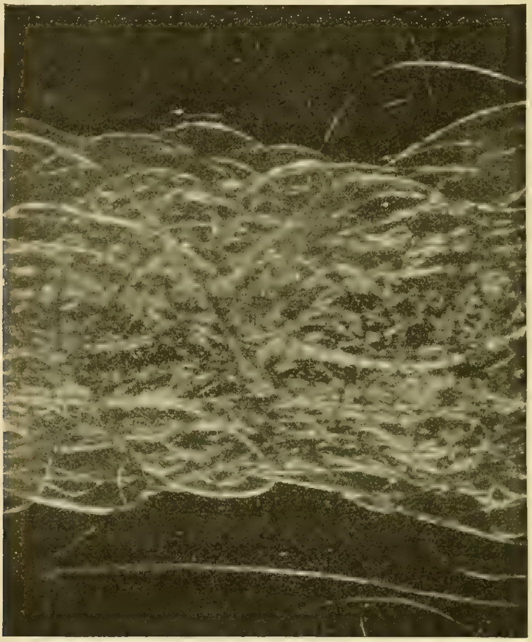


Fig. 25.—Sample of Condensed Woollen Sliver.

density, and the maximum amount of filament crossing, obtain. How markedly the woollen differentiates from the worsted structure, will be evident on comparing the fibre grouping and relation in the combed top (Fig. 24) and in the condensed sliver (Fig. 25). The lateral uniformity, the direct-line order, and the parallel co-extension of the fibrous ingredients, are the striking features of the former; as the involved cohesion, and sinuous, hooked and twirled formation

of the fibrous ingredients, are the striking features of the latter. The combed slubbing and the carded sliver are the basic material forms of all descriptions of worsted and woollen threads. With the fibre preparation for spinning thus widely differing, the yarns produced necessarily vary in constructive details and in structural arrangement even in the use, as in the specimens in Figs 24 and 25, of a similar quality of wool. It will be shown in treating of the application of the "Yarn Unit" how the manufacturing practice is extensible by the selection of one yarn or the other. For the present the points to be noted relative to each sort of yarn spun on the woollen principle are (1) the filament density of the thread, which consists of all kinds of fibre, however diversified in measurement, existing in the material selected; (2) its firm central coil with its rough, sinuous exterior as compared with worsted, cotton or linen yarn; (3) its disposition to develop a fibrous cover on both sides of the cloth; and (4) its structural character provides for textural diversification as obtained in the processes of cloth finishing.

55. *Metallic Threads.*—In addition to what may be termed the standardized materials employed in yarn construction, and to which reference has been made, the range and character of the dress trade admit of the use of all substances, natural or manufactured, which may be reduced to a weavable form. For acquiring specific features in the design or fabric style, threads of a mineral origin are applicable. Cloths composed partially or wholly of metallic threads have from time to time been woven. In China the art of weaving threads made of the precious metals was understood at an early date. Moreover, on the exploration of India in the Middle Ages by Portuguese, Venetian, and English merchants, textures made of gold were found to be a native production.

Artistic specimens of Florentine craftsmen of the thirteenth to the seventeenth century, in which gold and silver threads are used, are still extant, and an example of this class, woven in the fifteenth century, is photo-micrographically illustrated

in Fig. 26. As magnified, the constructive scheme followed, and the distinguishing details of each kind of thread combined, are rendered visible, namely (1) the varieties of warp and weft yarns, including linen in sections *a*, gold and silk strands folded into compound threads in parts *b*, the flat ribbon-like bands at *c*, and the multi-fold gold threads in section *d* ; (2) the minute textural characteristics arising out of these distinctive thread structures ; (3) the full plan of intertexture, so that the warp and weft interlacings are clearly translatable ; (4) the relative value of each species of thread, first as a textural unit, and, second, as an effect producer ; and (5) the degree of yarn compactness, suggestive of the loom setting and of the frictional strain each class of thread sustains in the making and in the application of the fabric.

The Indian art weaver has carried this extravagance, in the admixture of priceless with ordinary classes of materials, to a point of lavishness undreamt of in the Western school of design, as instanced in the Baroda tapestry or carpet. This production resembles in the ground sections a woven pile structure, but literally it is a loom-formed and embroidered piece of jewellery—a tissue of pearls, rubies, sapphires, and diamonds.

56. *Modern Practice and Threads made of Mineral Substances.*—Modern practice discounts the use of gold and silver threads, but resorts, in a limited way, to the insertion, into either the warp or weft of the texture, of metallic strands assorted with yarns of a suitable diameter and grade of fibre. Figs. 27 and 27A are examples of this order. The utility of the metallic threads consists in the scintillating lustre acquired, which is distinctive in effect from the lustre characteristic of thrown silk threads. The contrast, as developed in the actual fabrics, is not, however, clearly distinguishable in the photographic reproductions. Fig. 27 presents, in the cloth, three species of textural contrast due to the cotton warp and weft, composing the sections in plain interlacing, the spun silk weft details, and the spottings in gilt shots of weft which are floated without stitching on the face of

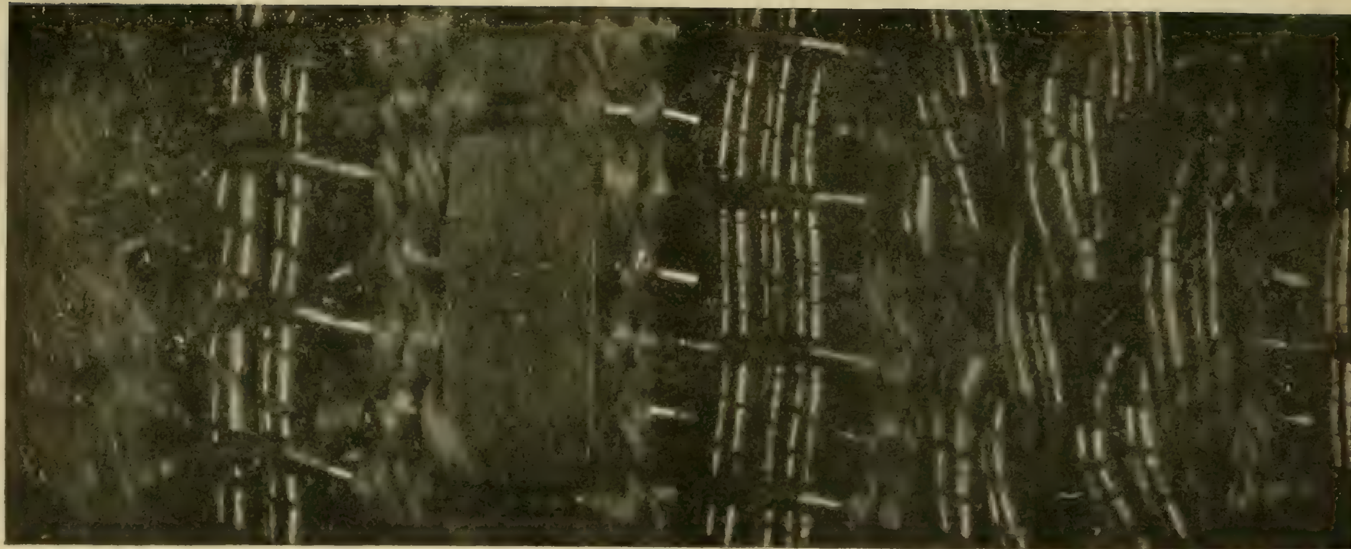


Fig. 26.—Florentine Fabric with Fold-Thread Interlacings.

the pattern. In Fig. 27A the metallic threads are applied in both the warp and the weft. Those inserted into the

FIG. 27.—COTTON-YARN AND METALLIC-THREAD TEXTURE.

warp (stripings A) appear bright and distinct, but those used in the shuttling and making the central portion of

FIG. 27A.—SILK AND METALLIC-THREAD SPECIMEN.

the leaf come out in a subdued or grey tone. The specimen is, therefore, instructive in illustrating the nature of the phenomena of the direction of the rays of light in viewing textures composed of these yarns. With the power of illumination in coincidence with the lateral surfaces of the threads the "lustre" is accentuated, which partially explains the scintillated colouring and textural qualities produced in this class of woven combination.

When strands of a metal category are employed, they may be folded, as in Fig. 27. with cotton and linen threads for the purpose of enhancing their weavable structures ; but in the case of mineral fibre, e.g. asbestos, being used, it is prepared and spun into an individual yarn of a like formation to the yarns made of other sorts of textile material.

57. *The Twine Factor in Spun Yarns.*—Yarn structure, in any quality or description of material, is variable with the degree of twine, or turns per inch, imparted into the thread in the spinning operation. The terms "hard" and "soft" twist, applied in the trade, have a relative meaning, inasmuch as the length of staple of which the yarn is composed, and the yarn counts, regulate the twine factor in producing a specified class of yarn. "Twist" concerns, in the first place, the elasticity and breaking strain of the thread, and, in the second place, the application to which the yarn is put in commercial manufacture. Thus, weaving range and work are affected, as well as the make and style of the finished cloth, by the amount of twine in the warp and weft threads employed. Some cloths necessitate the use of yarns loosely spun, as in acquiring textures of a soft handle or with a fibrous surface ; and others, as in voiles, crêpes, and fine, clear twilled goods, necessitate the use of yarns of a maximum twist. Between these two extremes in "twine" there are the ordinary types of yarn in which the twist is adjusted to produce a yarn of sufficient elasticity to sustain satisfactorily the tension applied in rapid weaving, and, at the same time, give the required quality of fabric.

The technical terms of "right-hand" or "crossband," and "left-hand" or "openband," signify the direction in which the twist is developed in the thread during spinning. In regard to the two descriptions of yarn which are in this way obtained, it is a general method, in cloth construction, to apply one "twist" of yarn in the warp and the reverse "twist" of yarn in the weft. But the rule is not hard and fixed, and is subject to modification with the weave effect and textural result to be acquired. It is the practice to follow in the manufacture of fabrics in which smartness and clearness of surface is essential, but may be advantageously departed from in making cloths in which the warp and weft intersections are not intended to be visible in the finished goods.

Twills, venetians, sateens, and other similar weave structures are, as will be shown, developed by having due regard to the direction and degree of "twine" in the yarns selected. They impose the combination of firm-spun warp and medium-spun weft yarns; whereas soft-handling dress serges, wool cashmeres, velveteens, flannel textures and habit cloths may be correctly made by combining loose-spun yarns. On the other hand lustre dress goods, cotton poplins, and many crêpe cloths are composed of hard-twisted yarn one way and soft-twisted yarn the other. In the instance of repps, gauzes, lenos, and voiles the emphasis of the distinctive characteristics seen in the textures, is dependent upon the selection of yarns of the requisite hardness of twist.

58. *Folded Yarns and Twine Insertion.*—"Twine" has so far been considered as a factor irrespective of whether the yarn specified be single or folded in character. It has other and important relations as it bears on the twisting together of two or several threads into a compound yarn unit. For example, in producing two-ply or multi-ply yarns the separate threads combined, and also the resultant folded yarns, may be modified in the process of doubling or folding. First, in combining two threads, say, A and B, both of the same kind of twine, and folding them by twisting in conformity with the original twine

in each thread, the hardness of the two threads is augmented; whereas by twisting them in the reverse direction of the original twine has the contrary effect, and would cause both threads to be looser and softer in structure. Second, in combining a thread C, right-hand twist, with a thread D, left-hand twist, and making them into a folded yarn by (1) twisting to the right, and (2) twisting to the left would change the respective threads thus—

(1) C would be rendered firmer and D a softer yarn.
(2) D ,, ,, softer ,, C a harder yarn.

In each form of doubling the quality, tensility, and features of the folded yarn developed would be also affected. Increasing the multiple of the single threads employed, and using threads of different materials or of a different system of construction, adds to the technical interest and value of the compound yarns obtained, more especially when it is taken into account that each type of folded yarn has a distinctive utility in fabric building and as a quality producer in cloth manufacture.

59. *Compound Yarns and the Dress Trade.*—The problem, as it concerns the dress industry, is exemplified in the folded-yarn specimens illustrated in Fig. 28. The thread units applied in the formation of each yarn type, and the practice adopted in the folding operation, are specified in the Table shown on page 70.

60. *Types of Folded Yarns.* Series A (Fig. 28).—These examples are illustrative of the kind of yarn resulting from folding two yarns of the same counts by varying the degree of twine inserted in the process of doubling, thread No. 1 being soft twine, thread No. 2 medium, and thread No. 3 hard twisted. Examining the yarns under magnification—as should be done in all the specimens—reveals the slacker structure of No. 1 as compared with No. 2, and No. 2 as compared with No. 3, and also the evener, fuller thread obtained as the turns per inch increase in the doubling; for this factor, as it augments, reduces the twist ingredient in the single threads.

TABLE V

Folded-Yarn Construction—Fig. 28

M = Medium Twine. ′ = Right-hand Twist. ` = Left-hand Twist.
S = Soft „

Series	Specimen Nos.	Yarn Units.	Twine in Folding Operation.
A	1	1/40's Botany M′ twisted with 1/20's M′	S`
	2	1/40's „ M′ „ „ 1/20's M′	M`
	3	1/40's „ M′ „ „ 1/20's M′	H`
B	4	1/40's „ M′ with 1/20's Crossbred M′	M`
	5	1/20's „ M′ „ 1/40's „ M′	M`
	6	1/40's „ M′ „ 1/40's Botany M′	M`
	7	1/40's Crossbred M′ „ 1/40's Crossbred M′	M`
C	8	1/40's Botany M′ with 1/40's Botany M′ and 1/40's Botany M′	M`
	9	1/40's „ M′ „ 1/40's „ M′ „ 1/40's „ M′	M′
	10	1/40's „ M` „ 1/40's „ M′ „ 1/40's „ M′	M′
	11	1/40's „ M` „ 1/40's „ M′ „ 1/40's „ M′	M′
	12	1/40's „ M` „ 1/40's „ M` „ 1/40's „ M′	M`
	13	1 40's „ M` „ 1/40's „ M` „ 140's , M′	M′
	14	1/40's „ M` „ 1/40's „ M` „ 1/40's „ M	M`
D	15	30 skeins Saxony M′ with 60's/2-fold silk	M′
	16	„ „ M` „ „ „	M′
	17	„ „ M′ „ „ „	M`
	18	„ „ M` „ „ „	M`
E	19	2/40's Botany M` twisted with 1/40's Botany M′	M′
	20	2/40's „ M` „ „ 1/40's „ M`	M′
	21	2/40's „ M` „ „ 1/40's Crossbred M′	M′
	22	2/40's „ M` „ „ 1/40's „ M`	M′
	23	2/40's „ M` „ „ 1/40's Botany M′	M`
	24	2/40's , M` „ „ 1/40's „ M`	M`
	25	1/40's Crossbred M′ with 1/40's Botany M′=M`, and 1/20's Crossbred M′	M′
	26	1/40's „ M′ „ 1 40's „ M′=M` „ 1/20's „ M`	M′
	27	1/40's „ M′ , 1/40's „ M′=M` „ 1/20's „ M′	M`
	28	1/40's „ M′ „ 1/40's „ M′=M` „ 1/20's Botany M`	M`
	29	1/40's „ M′ „ 1/40's „ M′=M` „ 1/20's „ M′	M`
	30	1/40's „ M′ , 1/40's „ M′=M′ „ 1/20's Crossbred M`	M`
F	31	30 sks. Saxony M′ with 60's/2 silk M′ and 2/60's Botany M′	M`
	32	„ „ M` „ 60's/2 „ M′ „ 2/60's „ M′	M`
	33	„ „ M′ „ 60's/2 „ M` „ 2/60's „ M′	M′
	34	„ „ M` „ 60's/2 „ M` „ 2/60's „ M′	M′
G	35	2/30's Botany M′ with 30 skeins Saxony M′	M′
	36	2/30's „ M` „ 30 „ „ M′	M′
	37	2/30's „ M` „ 30 „ „ M	M′

Series B.—Here yarns of different counts and qualities are combined. No. 4 is a compound of 1/40's Botany and 1/20's crossbred, both medium spun, and crossband or left-hand twisted in the folding. The yarn unit of the thicker diameter forms a distinguishing feature of the two-fold structure. This is emphasized in No. 5 where the Botany is 20's and the crossbred 40's counts, and hence the greater contracting value of the

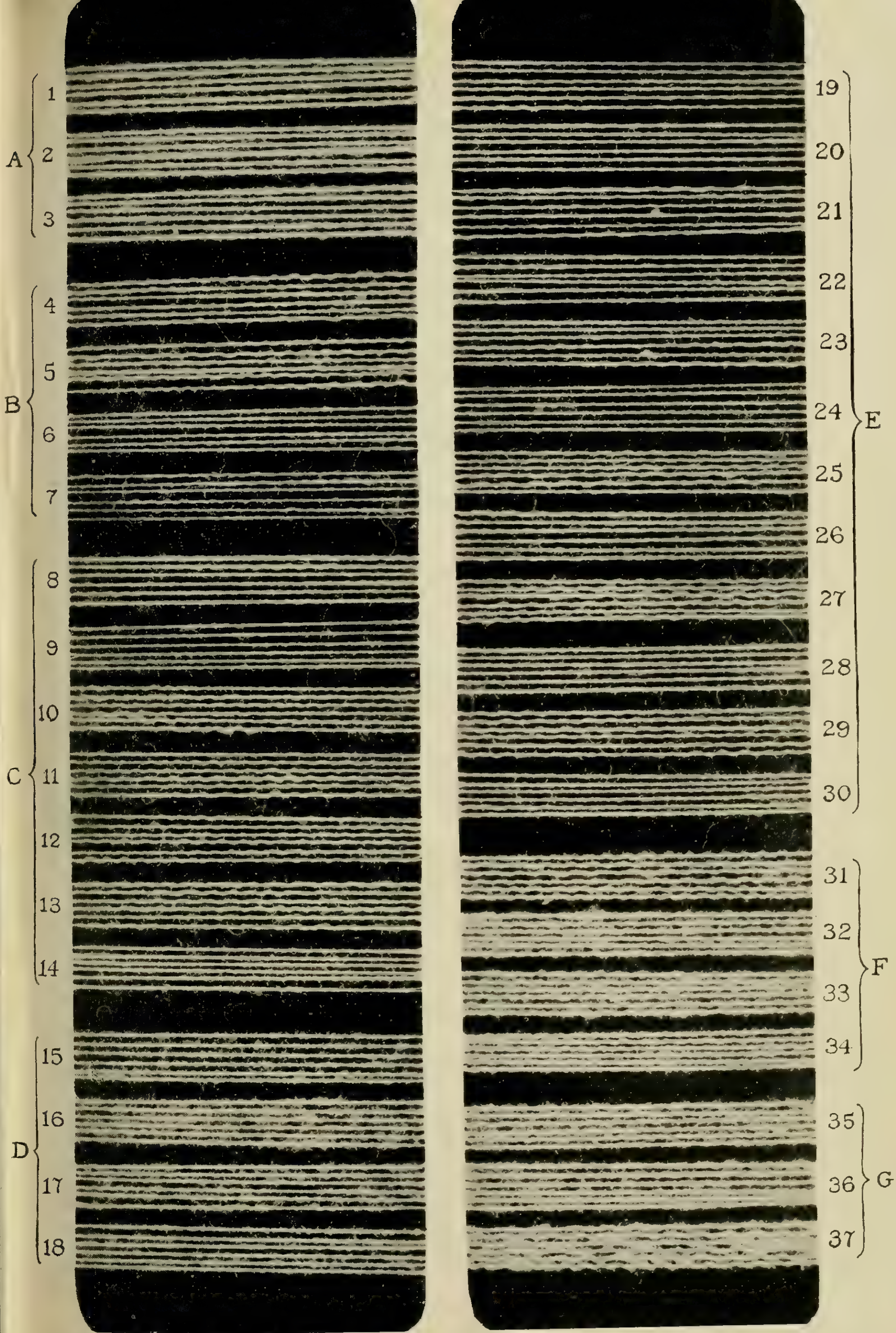


Fig. 28.—Folded Yarn Specimens—Natural Size.

Botany causes the latter to wave the surface of the folded yarn. Combining threads of the same counts (single 40's Botany, No. 6) and both flyer spun, yields a yarn of special evenness as to elasticity test and surface features; while changing one of the units to 40's crossbred (No. 7) makes a more "wiry" yarn and one less smooth and equalized in formation.

Series C.—Three-fold yarns are also typified in this series of specimens. First, three threads, in No. 8, of single 40's Botany, each openband twine and medium spun, are twisted together crossland twine, which gives a yarn of apparently a fuller diameter than yarn No. 9, consisting of like thread units but with the twine reversed in the twisting. The cause of this differentiation is a reduction in the turns per inch of the original threads in No. 8 in the folding operation, and the addition of twine in such threads in the folding operation in specimen No. 9. In yarn No. 10 a further element is introduced, one of the three threads is the reverse twine of the other two, and this thread receives a supplementary degree of twist in the folding work, whereas the spun twist of the two threads is diminished, hence the irregular or somewhat corrugated surface of the 3-ply yarn. Reversing the twist in folding—(No. 11) enables the single threads of a corresponding twine to control the formation of the compound yarn, so that, though the gimped disposition is still traceable, it becomes less accentuated. In specimen 12 two of the single threads are crossband and one thread openband twine, with the folding twist agreeing with the former and opposing the latter. On the other hand in No. 13 the folding twist coincides with that of the third thread, reducing the turns per inch in two of the threads, making a softer but still a slightly waved-surface yarn. For levelness of structure No. 14 is suggestive, resembling No. 9 in the "folded" and "spun" twist being the reverse of each other, with, however, this distinction, the folded unit No. 9 is medium right-hand twine, and that of No. 14 medium left-hand twine.

Series D.—The selection of yarns made of different materials provides for the acquirement of the other qualities and types of compound threads. The four specimens (Nos. 15 to 18) consist of two yarn units, namely, 30 skeins woollen and 60's /2-fold silk. Nos. 15 and 16 are both right-hand twine in the folding, which has increased the turns per inch in the 30 skeins thread in No. 15 and developed the effect due to the silk, but subtracted from the twine ingredient in the 30 skeins thread in No. 16, and so far softened in structure as to partially conceal the 60's/2 silk thread. Imparting the twine in folding in the opposite way, and also leaving that of the "spun" twist unmodified in the woollen, produces similar compound yarns as seen in specimens Nos. 17 and 18.

Series E.—These yarns are all of the 3-fold category, but Nos. 19 to 24 are formed of 2-fold 40's with single 40's; and Nos. 25 to 30 of two threads of single 40's with one thread of single 20's. Further, in the first group, the yarn units are all of the Botany quality, but in the second group they include both Botany and Crossbred threads. Each specimen exemplifies a principle and practice in folding. Nos. 19 to 22 are right-hand twisted in the doubling, with the 2-fold 40's threads left-hand twine, and the single threads modified thus: Nos. 19 and 21 right-hand twisted and Nos. 20 and 22 left-hand twisted, with the threads Botany and Crossbred respectively. The difference, therefore, between 19 and 21 or 20 and 22 is caused by changing the quality of the single yarn. This modification of the appearance of the folded yarn is the more noticeable in specimens 20 and 22, the former being the leveller and smoother thread. Specimens 23 and 24 are interesting as showing the alterations in the folded yarn caused by the single 40's being untwisted by doubling in the first, and supplemented in twist in the second instance, with the resultant diameter of the 3-fold yarn perceptibly diminished in No. 24, and rendered more even in construction in No. 23.

With the interchange of thread units from Crossbred to Botany and also in the counts, yarns of a still more varied

character are obtained. Analyzing specimens 25 to 30 will make this clear. Taking No. 25, a single 40's Crossbred (M′) is doubled with a single 40's Botany (M′) in the reverse twine or M‘ ; then this 2-fold thread is twisted with a 20's (M′) in the same direction as the 20's yarn. There are here two processes of compound thread production, the 2-fold yarn consisting of threads of equal counts and corresponding twine, and of Crossbred and Botany quality respectively. With this yarn a third thread (Crossbred) is folded, and of the same thickness as the two single threads (40's) combined. This system of multi-ply thread making is also practised in specimens 26 to 30 inclusive. What originates the dissimilarity in the surface elements and in the evenness of the several compound structures, is the relation of twine in the single threads to the twine direction in the folded yarns. It will be observed that Nos. 28 and 30 are the more regular and even in construction. Their dissection shows that specimen 28 agrees with specimen 30 in the twist inserted in folding, with the single thread in No. 28 Botany, and in No. 30 Crossbred. Examples 27 and 29 also differ in the single thread units ; both are rippled but 29 is the softer in character.

Series F.—These yarns consist of five threads folded into one, namely, of one thread of 30 skeins Saxony, one thread (= two single threads) of 60's/2-fold silk, and one thread of 2-fold 60's (= two single threads) Botany worsted. The silk unit is emphasized in specimen 31, subdued in specimen 32, and has an intermediate effect in specimens 33 and 34. In each of these multi-fold yarns, the 2-fold 60's worsted is right-hand twine, hence, in the folding, the turns per inch in this thread are decreased in Nos. 31 and 32, and increased in Nos. 33 and 34. The worsted is not, however, so assertive in shaping the characteristic of the folded yarn as the carded or woollen thread. The latter, as a consequence of being softened in structure in the folding process in 31 and 34, and hardened in structure in 32 and 33, is responsible for the modifications in the type of the resultant yarn.

Series G.—The examples in this series are compounds of 2-fold 30's Botany and 30 skeins Saxony, or of worsted and carded yarns of a similar wool quality, and of, approximately, the same counts. They are typical of having, in folding, (1) the "spun" and "doubling" twist in coincidence, specimen 35; (2) the turns per inch augmented in the woollen and diminished in the worsted; and (3) the twine reduced in both the worsted and the woollen thread. The first practice yields a firm, the second a worsted, and the third practice a fibrous quality of folded yarn.

61. *Basic Principles in Folded-Yarn Construction—Fancy Twists.*—The specimens examined exemplify the basic principles in folding two or more threads together as they are comprised (1) in the selection of yarns of the same counts, with each

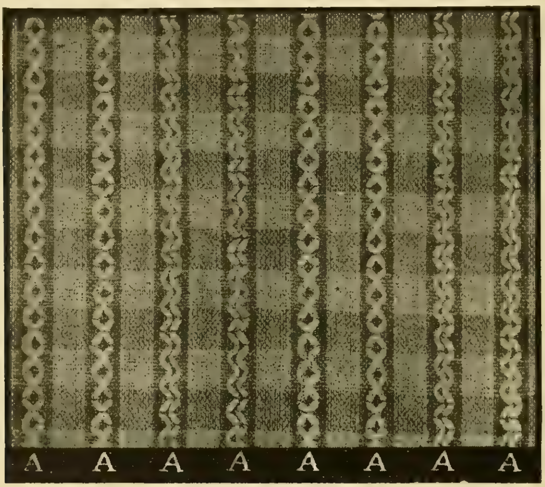
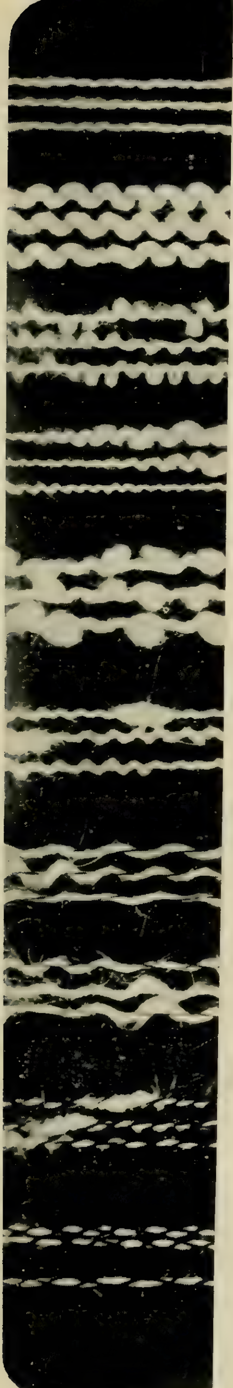


Fig. 29.—Cotton Style with Thick Folded Warp Ends.

thread twisted in a corresponding or in a different direction, and also in relation to the nature of the twine generated in the folding process; (2) in the combination, under similar twisting conditions, of threads of dissimilar thicknesses; and (3) in the use of threads varying in structure and in the



FANCY TWIS

5264—(*bet. pp.* 74 *and* 7

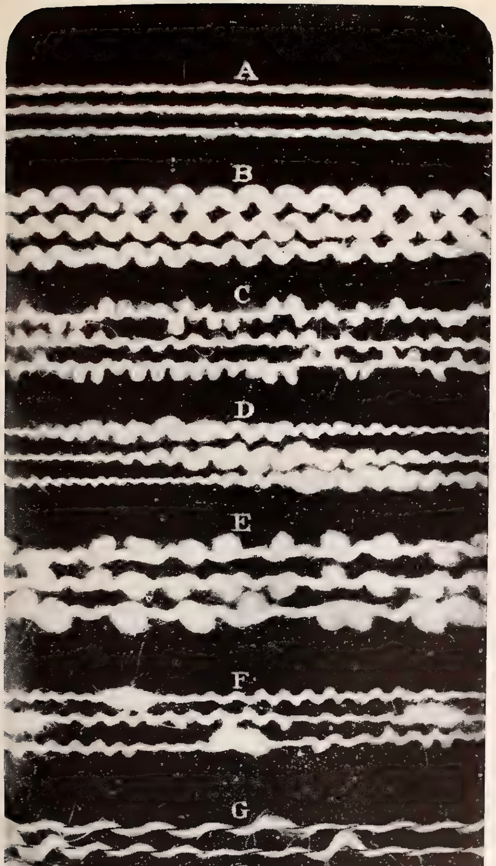


FIG. 30.
FANCY TWIST OR EFFECT YARNS.

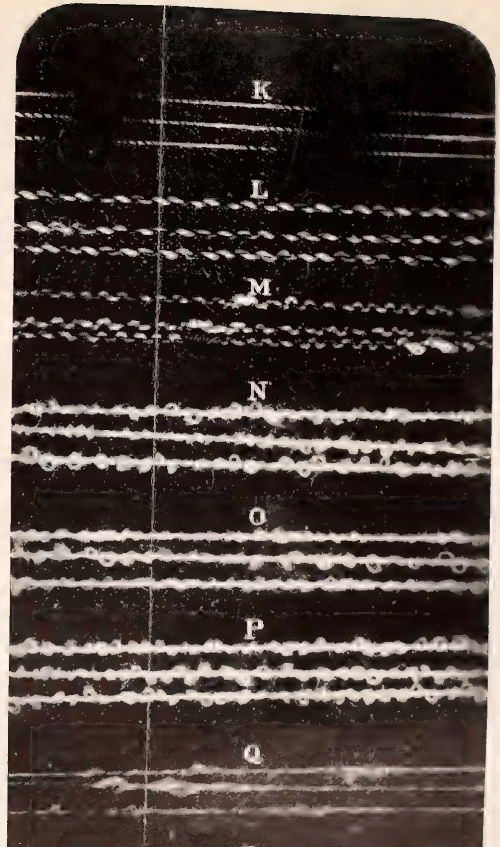


FIG. 30A.
FANCY TWIST OR EFFECT YARNS.

5264—(*bet. pp.* 74 *and* 75)

materials of which they are spun. Multi-fold yarns in which three, four, five, or a larger number of threads of one diameter are formed into a thick thread for giving a fuller quality of effect in the cloth than that characteristic of a single spun yarn of the required thickness, are also produced. Threads A in the striped and checked blouse texture in Fig. 29 are of this construction, being composed of five single threads of 40's cotton. Being more diversified in composition and in formation than thick single threads of equivalent counts, they impart clearness of tone to the pattern details to which they are applied. Such multi-fold yarns are, however, distinct in structure from "fancy" twists, which are strictly "effect" yarns (Figs. 30 and 30A) or yarns which develop definite features in the woven fabric. The systems of production are set forth in the dissected particulars, supplied in Table VI, of the "effect" and fancy folded yarns illustrated in Figs. 30 and 30A.

TABLE VI

PARTICULARS OF DISSECTED FANCY-TWIST YARNS

(Figs. 30 and 30A)

Specimen A.—Crimped or small Gimped Yarn consisting of a fine worsted roving and cotton thread twisted together, and afterwards retwisted in a contrary direction with a second cotton or binding end.

Specimen B.—Accentuated Gimped Yarn formed of two roving threads slackly twisted one with the other, and subsequently refolded with a small cotton thread, the latter being delivered under tension and the former delivered loosely.

Specimen C.—Looped Fancy Yarn obtained by running a mohair thread under easy tension and twisting it with a cotton yarn, followed by binding the two into one by folding with a further cotton thread.

Specimen D.—Flaked and Gimped Yarn made of a mohair roving and of a worsted or cotton thread with the mohair delivered intermittently, and to which a binding thread is subsequently added in refolding.

Specimen E.—Curl Yarn produced by using a mohair or lustre worsted roving twisted with a worsted thread, with the mohair so delivered that it may be drawn into curls by the "up-and-down" movement of the looping motion. For binding the two-fold thread thus acquired, it is retwisted, in the opposite direction to the initial twist, with a single cotton, worsted, or other yarn.

Specimen F.—Knopped and Gimped Yarn also three-fold in structure.

The knops are formed by twisting a mohair roving with a cotton thread, in which operation the mohair is intermittently delivered. The resultant two-fold yarn is then retwisted with a binder thread.

Specimen G.—Slackly-twisted Waved Yarn—formed of a mohair or lustre worsted and of a Botany worsted or cotton thread, the mohair being in the process slackly tensioned. A degree of the twist imparted is reversed in applying the binding end in the refolding operation.

Specimen H.—Similar to *G* but with still less tension applied to the mohair yarn in the process of twisting.

Specimen I.—Knopped Yarn made, in the first place, by twisting a mohair thread with a cotton thread, which, in the second place, is wrapped by reverse twisting with a cotton end.

Specimen J.—Similar to *I* without the use of the knopping motion in the first operation of twisting.

Specimen K.—Flaked Cotton Twist. This is a two-fold yarn in which black and white threads are alternately delivered at varying speeds.

Specimen L.—In this Fancy Yarn two worsted threads are first folded and then retwisted with two small ends of a different colour, when the four-fold yarn is reverse-twisted with a single yarn.

Specimen M.—Diamond or Chain Twist slightly knopped and consisting of one lustre thread and two fine cotton threads. In the first operation, a mohair and a cotton thread are combined, twisting from left to right, and in the second operation a second cotton thread is applied, twisting from right to left.

Specimen N.—Irregular small Curl or Loop Yarn formed of three threads, namely, lustre worsted and two cotton ends, and in a similar manner to specimen *C*.

Specimen O and P.—Variations of Yarn *N*.

Specimen Q.—Fancy Yarn acquired by allowing slubs of various colours to be run intermittently with the threads used in twisting.

Specimens R and R^1.—Slub Yarns usually made of two fine cotton threads in which condenser slivers are combined at regular intervals in the twisting operation on the same principle as in yarn *Q*, but the slivers or slubbings less continuously delivered.

Specimen S.—Knopped Diamond Twist made in the same way as specimen *J*, but with the worsted roving knopped and the chain or diamond characteristic better developed.

62. *Folded and Multi-ply Twist Threads.*—(*See* Figs. 30 and 30A.)

Gimp Yarns.—The ordinary types of these yarns are composed of two single-spun threads. Two- and three-fold specimens (Series A to G, Figs. 28) have already been referred to.

The gimped feature is developed in 2-ply yarns when the component threads are of like or dissimilar counts but of opposite twine, as the twisting of the two into one yarn deducts from the turns per inch in one thread, and adds to the turns per inch in the other thread. As the disparity in the counts of the respective thread units increases, the gimped characteristic becomes accentuated, as will be observed in samples A and B. Thick and thin places are formable in the resultant yarn (specimen D) by delivering the single threads at different speeds during twisting, and allowing the degree of twine to remain constant.

Curled and Gimp Yarns are similarly constructed, with one of the threads—mohair or lustre worsted—released at intervals by the rollers of the twisting frame, enabling the thread so treated to be drawn into loops or curls as seen in C; or such intermittently delivered thread may be shaped into beads or knops, as in F.

Corkscrew and Waved Yarns (G and H) may be slack or intermediate twisted and made of three separate threads, two being fine in counts and frequently cotton, and the third thread comparatively thick in counts and loosely spun from a lustrous class of material. The thicker thread is irregularly delivered, and in lengths corresponding to the dimensions of the "waved" or "looped" effect desired.

Buckled or Looped Yarns (E) are a species of curl twist, with, however, the buckled details compactly developed in the length of the compound thread.

Chain and Diamond Twists.—In these yarns (I, J and L) three threads are ordinarily employed, one forming a centre or core thread, with the two other yarns wrapped round it in reverse directions. Thread units of the same quality and diameter are combinable; but, as shown in the specimens, they may differ in these respects and also in colour. The surface of the twist may, in addition, be knopped or curled by the thread made of a bright description of fibre.

Flake Yarns.—Specimen K is a fine cotton twist of this

formation. Two threads are used, and these are freely delivered and checked in the delivery in succession, causing tight and slack-twisted lengths of twist yarn to be alternately produced.

Three-colour Yarns.—As three threads are usable in these twists, they may be *beaded*, *knopped* (M), *gimped* (N, O, P), or *curled* in construction.

Slub Twist Yarns.—By selecting, as one component of the folded yarn, a condensed sliver or slubbing, and by delivering this intermittently in the twisting operation, compound threads of the character illustrated at Q are obtainable. More diversified yarns result from combining two or three shades or tints of slubbing and distributing these in the length of the twist in consecutive order.

Irregular Twists.—From the principles of fancy yarn construction defined it will be understood that, with their modification or elaboration, a varied assortment of irregular and unclassified multi-ply twists are producible. Two examples (R and S) are supplied, one of which consists of a 2-fold yarn wrapped with a third thread, and the second of a 3-fold yarn in which one thread is utilized in forming a special group of effects.

63. *Fancy Yarns in Dress and Costume Textures.*—These several descriptions and types of fancy twist yarns are adaptable to the different branches of dress, costume, and blouse cloth manufacture. They serve a useful purpose in the warping or wefting schemes of goods and builds of fabric in which the staple yarn employed is spun from cotton, flax, wool, or silk, and also in admixed yarn textures. Two specimens have been described in Paragraph 19. In the fine worsted and cashmere fabric illustrated in Fig. 13 twists of the mohair knop structure are effectively applied in the warp; and, as explained, yield the essential pattern details, or the compacted strands of white fibre which, in the raising of the piece, streak the surface of the cloth with long, hairy filament. In the second example quoted (Fig. 14) gimp yarn of the

character shown at A and B, Fig. 30, stripe the texture transversely. Other methods of applying such yarns are typified in Figs. 31, 32, 33, and 34. The first of these (Fig. 31) is a plain woven silk in which the gimped thread structure has been inserted in the weft for forming interesting lines across fabric. The use of an ordinary folded yarn of the same quality and thickness in this way would leave the lines severe, and produce a monotonous textural style. Variegated knopped yarns, formed of cotton, linen, and of cotton and silk, are applied to cotton blouse cloths on some such practice as indicated in Fig. 32, a fabric warped and woven thus—

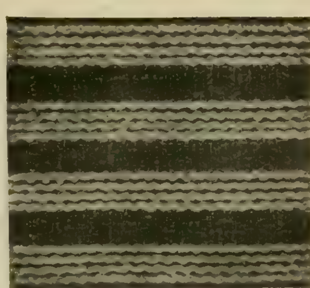


FIG. 31.—PLAIN SILK TEXTURE LINED WITH GIMP YARN.

Tint A—Threads or Picks		8	8	8	8	–	–
,, B—	,, ,,	8	–	8	20	38	20
Fancy Yarn —	,, ,,	–	′	–	′	′	–

Here, and in all similar styles, the overchecking lines, in fancy

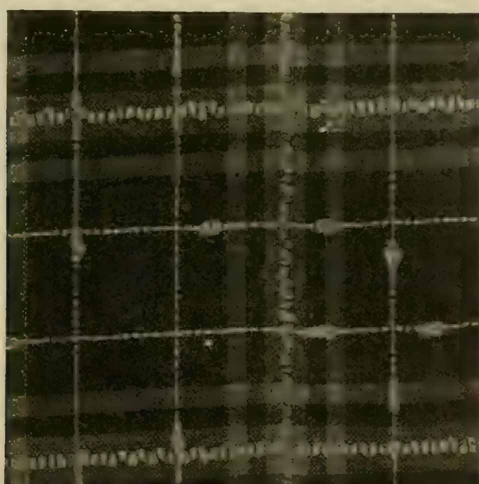


FIG. 32.—CHECKED BLOUSE TEXTURE WITH EFFECTS IN KNOP TWIST YARN.

yarn, form the special and novel feature of the design. Worsted and tweed costume cloths present a fibrous surface on which to display the yarn structure and composition. This surface

FIG. 33.—CROSSBRED WORSTED COSTUME CLOTH WITH CURL-TWIST YARN EFFECTS.

contrasts with the clear, bare surface in cotton and linen fabrics, and results in the twist threads being less distinctive in tone, inasmuch as they blend more satisfactorily with the plain or ordinary yarns with which they are combined. The examples in Figs. 33 and 34 are suggestive of the application

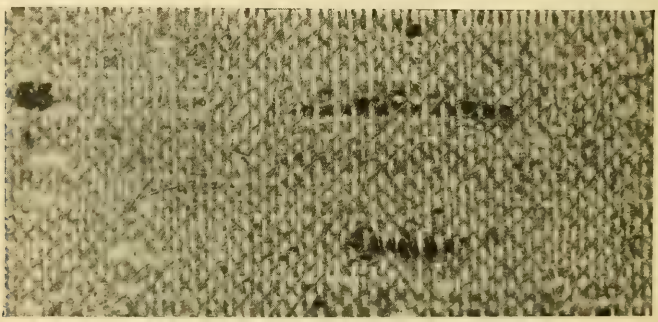


FIG. 34.—DONEGAL TWEED COSTUME CLOTH WITH CARDED KNOP YARN FEATURES.

of curl and knop yarns to two qualities of woven manufacture—one a Crossbred texture and the other a Donegal tweed. In the first, small curl yarns are used, and, in the second, knopped threads in which the knop is developed in the carding and not in the twisting operation.

CHAPTER III

SILK: THROWN, SPUN, AND ARTIFICIAL

64. *Thread-like Structure of the Silk Filament.*—Silk, unlike other varieties of material employed in textile fabrication, already possesses, in the natural state, the form and continuity of length of a fine thread or yarn. While other descriptions of fibre require to be subjected to mechanical treatment in order to convert them into a thread-like structure, silk is emitted by the silk worm (*Bombyx mori*) as a continuous filament and wound into an egg-shaped cocoon. Hence the silken thread or filament from such cocoons may be reeled from end to end, that is, from the beginning to the termination of the

process of production by the worm, and in a similar manner as spun yarn is reeled for hanking purposes. The twin filament from a single cocoon is too fine and delicate for ordinary use in manufacture, but by the combination in reeling, of the filaments from several cocoons, warp (*organzine*) and weft (*tram* or *trame*), silk yarns are acquired.

65. *Superior Qualities of the Fibre contrasted with Cotton.*—As a textile filament, silk is superior in lustre, tensility, and in wearing efficiency, to either plant or animal fibre, and also in the fineness (counts) of the threads in which it is weavable. Its unique and superlative qualities are at once evident when textures made of cotton, linen, and silk are compared of a corresponding structure, thread diameter, and loom setting (ends and shots per square inch). The silk satin and damask, and the plain or twilled silk fabric, differ from cotton and linen fabrics of a like designation and construction. With the selection of mercerized yarns, the cotton sateen—warp or weft face, appears to approach the silk-woven tissue in lustre or sheen and in other technical characteristics ; but when the two textures are examined side by side for brightness and smoothness of surface, purity of colour, and kindness and quality of feel, the enhanced value of the silk manufacture is apparent. These differentiations in the features and properties of the silk satin and the cotton sateen, are to be equally discerned in plain, twilled, and the common sorts of texture. One manufacture, the silk, has an unsurpassed softness, flexibility, evenness of surface, and brightness of tone, and the other, the cotton, though highly suggestive of these technical elements, only exhibits them in a comparative or lesser degree.

66. *Silk and Linen Textures Compared.*—Extending the analysis to linens and silks, the contrasts between the woven products are likewise fully accentuated. Taking, for example, a typical damask, made, respectively, in silk and linen warp and weft yarns identical in counts, with the number of threads and picks in agreement in each, and both textures consisting

of one design scheme—the silk is firm and lustrous in structure, with the pattern details clearly visible, as a consequence of the distinction between the warp-face sateen in the ground and the weft-face sateen in the figure ; the linen is firmer and harder and fine in the make, but less lustrous, with the pattern details more subdued, as a consequence of the closeness of the relation, in effect, of the warp and weft weave units in the cloth. These obvious variations betwixt the fabrics have resulted in the use of silk weft in the finest classes of linen goods for the purpose of developing a superior richness of cloth, and of improved clearness of design delineation than is feasible in goods made of pure flax yarns.

67. *Silky Lustre.*—The lustre in silk runs through the thread, being present in the larva of the *Bombycid* moth or silk worm, of which the filament is composed. Its lustre is, in this sense, distinct from that of cotton, flax, and wool. In the two former, lustre may be acquired by pressure applied to the yarn or fabric, chemically prepared, as in mercerizing and in calendering for assisting the mechanical action, and rendering the "gloss" produced more permanent in nature. In wool, lustre is mainly a derivative of the outer scales of the fibre, and is, therefore, a superficial but natural quality of the filament, and one which varies in degree with the class of wool selected. The lustre in cotton or linen is definable as a "glossy sheen" artificially induced. It is not inherent in the fibre as understood in the case of silk, which, after degumming, presents what is termed "silky," as distinguished from "metallic," lustre.

68. *Early Origin of Silk—Historic Data.*—That a raw material of such adaptable and special properties for loomwork should have been used from early times is in keeping with inventive progress in the manufacturing arts. For some 4,000 years silk-worm culture has been known and practised in China. The *Book of Odes*, compiled by Confucius about 550 B.C., contains poems of a much greater antiquity, in which references are made to cotton, serge and other fabrics, but particularly descriptive of textures for silken wear. From

China the knowledge of seri-culture and of silk-reeling and throwing, and possibly also of decorative (harness) silk weaving, was transmitted through India to Persia, and from the latter country by Alexander the Great to Egypt and Greece, and thence to the Roman world. In the fourteenth to the seventeenth centuries, the art of silk fabrication, from the natural fibre to the woven texture, flourished in Florence, Venice, and Genoa, and in the South of France, and was subsequently stimulated in England by the settlement of the Huguenot weavers in Spitalfields, London.

69. *Organization of the Silk Industry.*—The silk industry, as now organized, comprises in manufactured goods : (*a*) plain and decorative fabrics ; (*b*) lace, hand and frame produced ; (*c*) hosiery and knitted goods ; (*d*) embroidered, embossed, and printed textiles ; and (*e*) small-ware and passementerie textures. In class (*a*) are found the different styles of dress and blouse cloths, first, in plain, twill, and other elementary weaves ; second, in coloured cloths ; third in spotted and figured fabrics, simple and compound in structure ; and fourth, in decorative robe textures of the brocade and pile-woven varieties.

70. *Technical Terms applied to Silk Textures.*—Amongst the trade terms applied to silk manufactures, elementary in weave structure, the following may be mentioned—

1. Plain-Woven Fabrics : Taffeta mousseline, taffeta chiffon, crêpe de chine, glacé, diaphanes, e.g. ninon, tulle, voile, marquisette ; moiré or watered silks, e.g. moiré ondé, tabissé, semé de flammes, moiré français, moiré antique and moirés faconné.

2. Cord or Repp Structures : Gros de Tours, gros de Naples and gros royale.

3. Twilled Woven : Sarcenet (also taffeta make), surah, serge, and linings.

4. Sateen Woven : Satins—yarn and piece-dyed—satin mousseline, peau de soie, satin lumière, charmeuse, de Lyon ; soie radium, soie meteor, soliels, etc.

5. Cross or Gauze Woven: Chiffon gauze, mousseline, gauze, leno and striped and fancy gauzes.

6. Velvet or Pile Woven: Velvets, plain, terry, frisé, Utrecht, velours de nord, velours chiffon, velours sabre, and different kinds of plushes.

7. Coloured Silks or Fancies: Striped, checked, chiné or warp printed, foulard, chiffon, etc.

Mousselines, chiffons, and crêpes include the light, soft, delicate types of texture; and diaphanes those of a semi-transparent character. Gros de Tours and all silk cord stuffs are repped or ribbed across. Sarcenet and twilled fabrics are firmer in the build than the mousseline, and are applicable to linings. Irish poplins are a species of repp in which the warp is made of silk and the weft of wool fibre. Other silk unions comprise crêpons, lustres, Sicilians, matelassés, and various sorts of velvets.

The peculiarity—irregular crimpled appearance of silk crêpes—arises from the practice in dyeing and dressing. A glutinous composition is, in the work, applied to the pieces, and this, in stiffening the threads, neutralizes a degree of the twine inserted in their formation, and thus yields the textural property distinguishing this class of fabric.

71. *Watered or Moiré Silks.*—Watered silks are a further variety of plain goods. Their waved and indefinite figured character is obtained by passing two pieces, face to face, between a pair of pressure rollers, one of which is steam-charged and heated. However smooth and level the surface of a plain texture may seem, as it is formed by the interlacing of threads of warp and weft in alternate order with each other, it is, in reality, a grained surface, the fineness or coarseness of the grain coinciding with the diameter of the two series of yarns intersected. With the grain of one texture impelled into the grain of a second texture, while both are under tension, the minute unevenness in their surfaces is perfectly equalized. It follows that, in so bringing two woven surfaces into absolute conformity, such areas of the surface of each

texture as are subjected to the severer pressure, receive and retain the brighter lustre, and, conversely, such parts of the two pieces as are lesser affected in the operation, necessarily assume a duller lustre. These contrasts in lustrous tone, being irregularly distributed in waved lines, and in nondescript forms, on the face of the fabrics, produce the so-called "watered" feature from which the goods derive their commercial designation.

72. *Sources of Silk and Silk Waste Supplies.*—Silk-worm culture is industrially pursued in China, Japan, India, Persia, Turkey, Italy, France, and America. Japanese and Chinese silks have, in recent years, greatly improved in standard under the technical and scientific methods which have been introduced. The School of Seri-Culture in Tokio, is admirably equipped and organized, and the instruction imparted has raised the annual silk product of the country, and improved the efficiency with which Japanese silks are prepared for commerce. Chinese silks, known for their purity of colour and brilliant whiteness, are undergoing the same process of betterment. They, as those of Japan, are used in native textile manufactures, but are also extensively exported in the raw state to this country. Bengal silks are another important variety, the "country reeled" being, however, an inferior quality to the "filature" spun. The latter, in the better grades, enters into competition with European silk. Persia and Turkey are both silk producing countries, and, in this relation, are capable of considerable development by the fuller adoption of European practices as applied to silk-worm rearing and silk reeling. The silks of France, Italy and Switzerland rank amongst the finest produced. Scientific investigation and technical training have secured for France the premier position in the production of the silk filament, in silk thread preparation, and in the manufacture of silk goods.

The world's supplies of silk and "silk waste" are, however, mainly derived from China, Japan, and Italy, France not exporting the raw fibre, but manufactured goods; and the

silk product of other countries—Turkey, Persia, Switzerland, etc.—is more in the nature of a supplementary than of a substantial asset. As regards the United Kingdom, it acquires some 60 per cent. of its silk from China, with a growing supply from Japan. This restriction in the sources from which silk for British textile production is drawn, points to the desirability of Government measures being taken to encourage seri-culture in India and other parts of the Empire where the conditions are favourable.

73. *Seri-culture.*—The eggs deposited by the silk moth are no larger than mustard seed. At first they are of a yellowish colour, but in a few days assume a blackish tint. Incubators are now customarily employed, in which hatching is effected in about thirteen or fourteen days. While in the caterpillar stage the skin is changed four times. The worm (which feeds chiefly on mulberry leaves) increases rapidly in size while the skin is soft, measuring at full growth from 3 to $3\frac{1}{2}$ ins. in length, and weighing some 75 grains. Hummel states that "the silk substance is secreted by two glands symmetrically situated on each side of the body of the caterpillar, below the intestinal canal. Each gland consists of three parts—a narrow tube with numerous convolutions, the veritable secreting portion; a central part somewhat expanded and constituting the reservoir of the silk substance, a capillary tube connecting the reservoir with a similar capillary canal common to both glands, and situated in the head of the worm, whence issues the silk."

When the spinning period is reached, the silkworm develops signs of restlessness and proceeds to construct a sort of rough scaffolding, fashioned of flossy material, by intertwining filament with filament attached to adjacent points (twigs, etc.) for support. On this structure the labour of cocoon making is performed. The cocoon is approximately the size of a pigeon egg, the dimensions of the cultivated varieties being $1\frac{1}{2}$ in. by $\frac{1}{2}$ in., of Tussur $1\frac{1}{2}$ in. by $\frac{7}{8}$ in. and of certain wild varieties, 3 in. by $1\frac{1}{2}$ in. Frequently the length of the *bave* (= the *brin*

or two-filament silk thread) from one cocoon exceeds 1,100 ft. On gathering the cocoons, the chrysalis is destroyed by placing the cocoons in a heated oven (*étouffoir* or *séchoir*), raising the temperature sufficiently to destroy the worm without injuring the silk fibre. Should this not be done, the worm would gradually pierce through the silk coil and disrupt the length of the filament.

74. *Filament Fineness.*—Under the microscope the fibre shows a great uniformity of diameter measurement, with, however, slight variations in the layers of filament on the inside and the outside of the cocoon. Chinese, Italian, Japanese, and Bengal filaments, when thus examined, presented the following comparative diameters—

	Diameter of fibre from outer part of cocoon.	Diameter of fibre from inner part of cocoon.
Chinese	$\frac{1}{2150}$ fractional part of an inch.	$\frac{1}{2150}$ fractional part of an inch.
Italian	$\frac{1}{2150}$,, ,, ,,	$\frac{1}{2100}$,, ,, ,,
Japanese	$\frac{1}{1800}$,, ,, ,,	$\frac{1}{1650}$,, ,, ,,
Bengalese	$\frac{1}{2000}$,, ,, ,,	$\frac{1}{2200}$,, ,, ,,

Considering that each filament from sound cocoons is a reelable thread, if the silk fibre could be woven into a texture without further doubling, plain woven fabrics would be producible, constructed on the intersection basis of setting, with more than 1,000 threads and shots per inch.

It has been estimated that for making 16 ozs. of reeled thread, 12 lbs. of cocoons are required, and that these represent the total yield of from 2,800 to 3,000 silk worms, to supply which with food, during the caterpillar state, 150 lbs. of mulberry leaves are consumed. The weight of silk quoted might be converted into 16 yards of silk texture (*gros de Naples*) of an ordinary grade, and some 14 yards of a superior quality.

75. *Classification of Cocoons.*—All species of cocoons, when gathered, include a number of more or less imperfectly-formed structures, hence cocoons for commercial purposes are classified into the following categories: (*a*) *Sound* or *good* cocoons, which are not necessarily the largest, but which are even, compact, and free from external defects, so that they are normally windable without breakage; (*b*) *Pointed* or *irregularly-shaped* cocoons, which reel satisfactorily until the point of the cocoon is reached when the filament, being unduly weak and attenuated, gives out. (*c*) *Cocalons*, which are usually of a larger size than the average cocoon, but softer and looser in texture. They have a disposition to "furze" more readily than sound cocoons, and for this reason are reeled separately. (*d*) *Doupions* or *double-shaped* cocoons, the fibre of which is liable to be meshed, making correct reeling impracticable. (*e*) *Soufflons*, partially transparent cocoons of an open structure, or spongy in composition, and unfit for winding. (*f*) *Pierced* or *perforated* cocoons, and (*g*) *Choquettes*, or cocoons in which the worm has died in the work of thread production. These are classed as sound and faulty, the former being windable, though the filament lacks the brilliance of that from good cocoons, while the latter are unusable for reeling. Still further varieties are formed and designated *Calcined* and *Royal* cocoons. In the first, from the worm having been attacked by disease after the completion of its labour, the chrysalis becomes petrified, or, in some instances, reduced to a powdered dust. The second, on account of the cocoons having been pierced by the breeding moths, are not reeled, but prepared with the *soufflons* and *perforated* cocoons.

76. *Silk-Reeling.*—As described, the two-unit filament, obtained from each cocoon, is too fine and delicate in structure to be fit for manufacturing application. On these grounds several filaments, or the products of several cocoons, are reeled together.

The reeling frame is simple in construction, ordinarily consisting of a trough or bowl in which the cocoons are immersed

in soft warm water ; of suitable guide and tensioning rails ; and of the reel for hanking the threads. The object of the water bath is to release the gummy matter, and facilitate the unwinding of the cocoon, the gelatinous substance retained causing the filaments to adhere to each other in the formation of the compound thread required. At the beginning of the operation the reeler presses the cocoons with a *battage* brush—made of fine twigs and even at the ends—into the tepid water, gently stirring them meanwhile. The loose fibres of the cocoons thus become attached to the points of the brush, from which they may be drawn through the fingers and cleared of floss and other impurities. Taking four or more ends—the number varying with the sort of thread being prepared—they are passed together through the eyelet in the guide rail fixed above the cocoon bowl. Two such compound threads are then twisted with each other, to produce a cylindrical form of yarn as differing from a similar silk yarn in which the fibres lay flat or in a ribbon-like relation. Following this routine, the silk is wound into a skein or hank on the reel. Reeling is carried out to give any description of silk thread, such as that formed of the composite filament from one cocoon, and that made of the filaments from several to as many as 100 cocoons ; but, in ordinary practice, it is rare to exceed the amalgamation of more than thirty filaments in producing one thread unit. The balls of silk are not in the process run off to the extreme end, for the simple reason that the husk would be liable to foul the yarn. On nearing the completion of the silk, the chrysalis drops off the fibre, leaving the ball so much the lighter, which causes it to rise out of the water and come in contact with the guide rail of the machine.

An even thread, one absolutely uniform in size, is an essential object to be attained in reeling. This necessitates care and skill in the work of production, inasmuch as the filaments of the different cocoons are not of equal diameters, or degrees of tenuity. The art of reeling consists in uniting such fibres as coincide with the fineness and quality of the yarn required,

which is not strictly definable by the multiple of ends it contains as a thread formed of three, four, five, or six filaments, but as a silk thread consisting of 2–3, 3–4, 4–5, etc., fibres.

77. *Winding, Doubling, and Throwing.*—Raw silk is, before weaving, converted into one of three forms, namely: (*a*) Singles; (*b*) trame; and (*c*) organzine. The first may be reeled silk to which twist has been added for imparting tensile property; the second and the third are made by combining several reeled threads, with the *trame* quality loosely twisted, and the *organzine* quality firmer twisted and in the reverse direction to the single threads of which it consists.

The operations of silk-throwing and spinning include: (1) Winding from the reeled skeins or hanks on to bobbins; (2) sorting for quality after winding; (3) twisting or spinning, and (4) folding and twisting the requisite number of threads into one of a suitable size and structure. In winding, the skeins of silk are run off the reels or "swifts" and wound on to bobbins laterally fixed in the winding machine. It is followed by twisting for giving "singles," the twist being inserted on the flyer principle of spinning. Should the silk be intended for dyeing in the hank, the amount of twist is moderated. *Singles*, for *organzine*, are in the first operation twisted to the left, and then retwisted in the opposite sense. The doubling of two, three, or other number of silk threads is next effected; after which, bobbins of the two or multi-ply threads so prepared are mounted in the throwster frame. Here the threads, from two or more bobbins, are combined and spun into yarn which is delivered in hanks. The twist, generated in the construction of the yarn, develops a disposition to crinkle in the silk. This crimpiness is eliminated by steaming the silk thread while extended on the swifts.

The thread thus obtained is known as "hard" silk. It still contains the natural gum, which is useful in the operations

described on account of the adhesive qualities it gives to the fibre. The discharge of this gummy matter from the material is now done by boiling the skeins of thrown silk in a solution of soap and water, leaving the yarn soft and lustrous.

78. *Waste Silk.*—The term is descriptive of pure or raw silk fibre. The material is not a by-product but a resultant of a certain filament obtained in the making of the cocoon by the silkworm, or in the preparation of the silk thread. What is termed "floss" silk is derived from the network of fibre covering the cocoon proper. It is therefore a material acquired in the cultivation of the silkworm for "net" or "thrown" silks, and also in the production of the "wild" varieties of silk of which the Tussur is suggestive.

It has been shown that there is quite a number of sorts of damaged cocoons, the fibre of which is unreelable, and these constitute a second and important source of "waste" silk adapted for mechanical thread construction. Moreover, it will be understood that in reeling, winding, doubling, throwing, and spinning, some considerable amount of waste fibre is made; and that, by reason of the practices by which it accumulates, it will contain good and indifferent qualities, but largely the former. The sorts in which hard twisted ends and pieces of thread occur, necessitate great care in combing, unless the ends, etc., are picked out by hand.

To the descriptions of fibre got from defective cocoons have to be added what are technically termed "Knubbs," or cocoons which have been entangled and formed into attenuated meshes of fibre, as well as the rough, coarse-looking hanks of silk, styled "Punjam Books," and which consist of silken yarn which has been spoiled in the winding. The wild varieties of silk, in consequence of the cocoons being imperfectly developed and irregular in formation, are classed as unwindable, and hence yield an important "waste" staple, though not one of a high quality.

79. *Varieties of "Net" and "Waste" Silk Yarns.*—The

different varieties of silk yarns and the systems by which they are obtained are stated below—

TABLE VII

VARIETIES OF "NET," "WASTE," AND "WILD" SILK YARNS

A. Net and Thrown Silk Yarns—from
   (1) Degummed or boiled-off silks.
   (2) "Souple" or partially boiled-off silks.

B. "Waste" or Spun Yarns—from
   (1) "Floss" gathered from all descriptions of cocoons.
   (2) Fibre from damaged cocoons.
   (3) Fibre from the manufacturing processes in the preparation of Net or Thrown silk yarns.

C. "Wild" Silk Yarns—produced by
   (1) Boiling-off or English system.
   (2) Steeping (Schappe silks) or Continental system.

N.B.—In the making of the yarns in (B) and (C) there is a percentage of fibre or "noil" extracted in the combing process, which is valuable for admixture with other textile materials in union-yarn manufacture.

80. *Different Qualities of Waste Silk.*—Waste silks, being derived from such a diversity of sources, are necessarily of different qualities. Referring, for instance, to the waste products from China and Japan, and to those from European centres, the former are generally in a harder and more meshed condition than the latter, arising from the custom in the Far East of pressing the materials, somewhat promiscuously, in bales. Chinese "wastes" range in colour from pure white to a clear yellow in the better sorts, and from a full yellow to a brownish fawn in the inferior sorts. European wastes are fairly free from foreign matter, and of a tinted grey or yellowish colour. The class known as filature waste, resulting from the processes of throwing and spinning, occasionally contain a portion of hard ends and bits of yarn.

81. *Gum Discharging, "Boiling-off."*—After sorting, for classification as to fineness and quality, the first work is to discharge the viscid gum, which is done by two practices, that

of " boiling off " and that of " steeping " or " soaking." The former is the older and the English method. It is carried out in large wooden vats or iron pans, circular in shape, like a dye vat, perforated at the bottom and steam heated. Having run into the vessel a sufficient quantity of water, 10 to 15 lbs. of sliced white curd soap are introduced, and the temperature raised till the soap is in solution. Some 100 to 120 lbs. of silk are now placed in the vat, either in the loose state, or in prepared canvas cotton cloth bags. The whole is then brought to a boil. The finer varieties of Chinese waste only require a small percentage of soap, and to be in the vat for a short time, but other kinds, such as the dark coloured wastes, require protracted treatment, or the boiling and cleansing to be repeated two or three times. Bluing or tinting of silk, if done, is performed in the final stage of boiling, by adding to the bath the diluted colouring ingredient. For removing the liquid from the silk, the boiled silk material is passed between squeezing rollers, hydro-extracted and dried.

82. *" Schappe " or Steeping Practice.*—The " Schappe " or " steeping practice " consists in placing the supply of waste silk in jacketed pans, and pressing it firmly down, in which state it is retained by applying flatboards. Fermentation is induced by heating up the vessel periodically. After fermentation has continued long enough, the material is removed from the vessels, pounded, rinsed in clean water, and exposed in a suitable temperature for drying purposes. The idea in the system is to soften the silk without discharging the gum, whereas the idea in the English system, is a complete expulsion of all adhesive and gelatinous matter. In the case of the waste silks selected on the Continent, the practice is satisfactory. The softened gum left in the fibrils acts as filament " size " in the operations of dressing, combing, and thread preparation, reducing its diffusiveness, and rendering the " waste " less liable to work into " nibs " and hard " neps " of fibre.

83. *Routine of Spun-thread Production.*—The routine of silk

waste or spun-thread manufacture comprises (*a*) softening; (*b*) conditioning; (*c*) dressing; (*d*) spreading and lap making; (*e*) drawing; (*f*) roving; (*g*) spinning and (*h*) cleaning, gassing and lustring.

84. *Softening and Conditioning.*—To prepare the "waste" for combing and dressing, it is, after discharging and drying, passed through the softening machine, containing six pairs of fluted rollers which successively rotate forward and backward, but with an accelerated forward movement. This has the effect of loosening, opening, and smoothing out the staple. The batch of material, having been thus treated, is "piled" in the conditioning chamber, where it is mechanically dewed or sprayed, or manually sprinkled with water. In this humid state the fibres acquire "condition" or an increased suppleness, flexibility, and working fitness.

85. "*Filling*" *Operation.*—Prior to being transferred to the dressing frame, the "waste" is dealt with in the filling engine, consisting of a feed sheet—on which it is evenly distributed in lots of 3 to 5 lbs.—of feed rollers; of a series of porcupine rollers or leather bands covered with porcupine (pinned) clothing; and of a large cylinder mounted with twelve to eighteen combs. It is the function of the combs in the cylinder to gather up the staple as delivered by the feed rollers. When this has been done, the motion of the machine is interrupted while the attendant severs the draft of fibres on the respective combs; turning their free ends backward. This makes it feasible for hinged boards to be so operated as to grip the fringe of fibres. Then, by effecting a downward action of the boards, the "strippings" are taken in serial order off the combs, and the "fill"—i.e. drawn and straightened staple from each comb in the cylinder—is completed, which, in an eighteen-comb cylinder, would be equal to the formation of this number of boards or "books" of fibre required in charging the dressing frame.

86. *Dressing and Combing.*—The flat dressing type of machine has, in the first place, a frame A movable on its

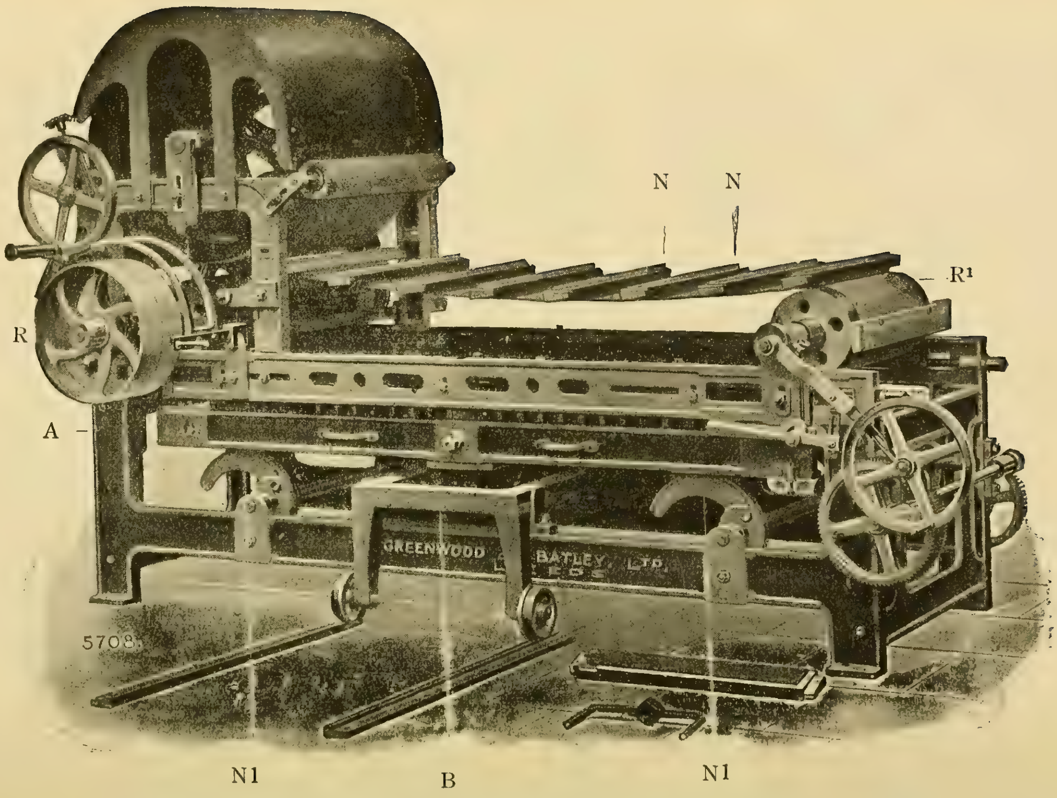


Fig. 35.—Flat Dressing Frame, with Self-acting Stripping Drum.

centre (Figs. 35 and 35A), divided as shown into two sections, and which may be made to traverse inwards and outwards on the carriage B. Each section is arranged to take a "fill" of books from the preparing engine. These are fixed vertically in the frame with the fringe of fibres projecting above the extremities of the boards. Second, the machine consists of an endless belt or web to which are secured the sectional combs N. The belt passes tautly round the surface rollers R, R^1, immediately over the frames, carrying the "books" of filament. The latter are, by the press cams, M, gradually raised, during the rotation of the web and its combs, until the whole length of the fibre has been treated or combed through, or the edges of the boards are nearly in contact with the pins of the combs N. At this stage in the work the press is automatically lowered, the frame turned on its centre, the carriage run out, and the process re-performed, with the object of the combing action being effected on the respective sides of the fibres successively. The combing pins in the first routine, move through the fringe of the material from left to right, and in the second, from right to left, and, in each instance, as the action continues, proceed from the ends of the fibres to the point where they are firmly held by the boards.

Obviously only one portion of the lengths of silk fibre has so far been combed; the dresser therefore removes the boards, a pair at a time, from the frame, taking one of the boards in the right hand on which the fibres are laid, and the other in the left hand, and neatly changes their position, presenting the uncombed section beyond the ends of the boards. Having thus reversed the strippings of material, and refilled frame A, the operation described is repeated.

87. *Short Fibre and Noil.*—As in the combing of wool or cotton, one of the features is the effective opening of the clusters of short fibre, so in the practice of "waste" silk combing and dressing. In the second combing there are commonly attached to the web sheet, narrow widths of card clothing S, Fig. 35A, intermediate between the combs, which

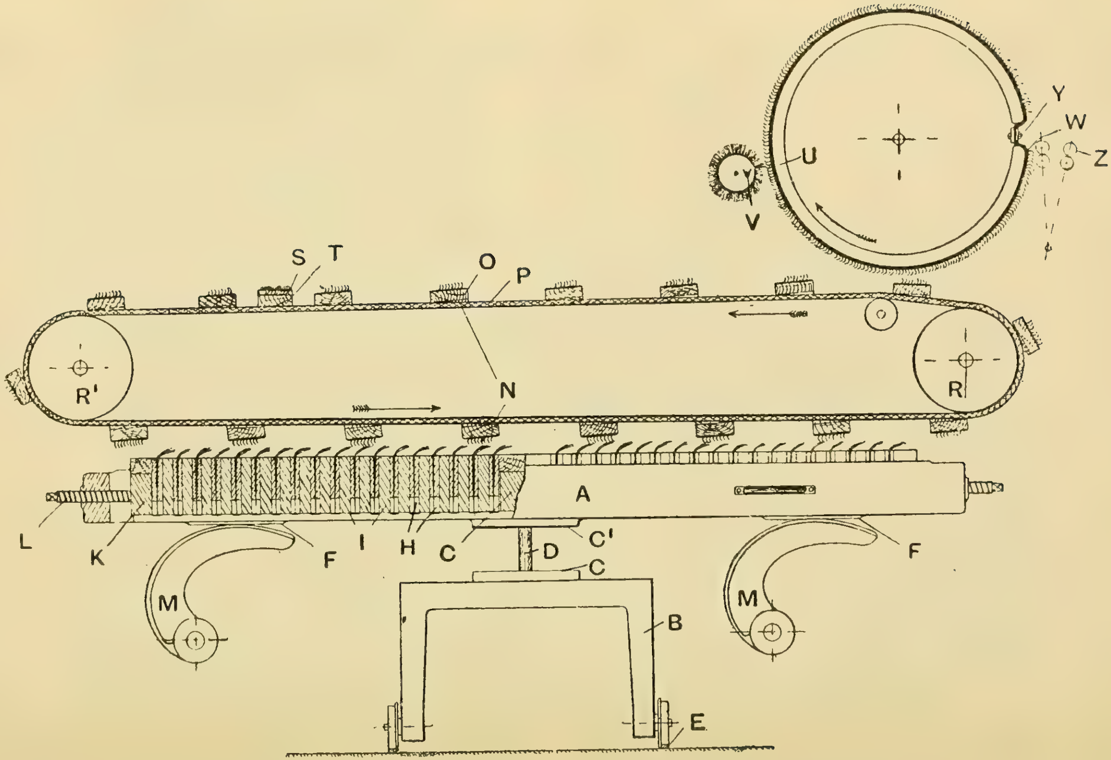


Fig. 35a.—Section of Waste Silk Dressing Frame.

have the effect of opening and levelling the more neppy fractions of filament.

The dressed product obtained is described as the dressers' "strick," corresponding to a "strick" of flax in linen yarn making, or to the lengths of cleared and equalized fibre ready for the preparing operations. There is a small percentage of fibre, which does not form part of the "stricks," such as that remaining in the pins of the combs. This becomes, when extracted, the silk "noil." A modern method of clearing the combs of this fibre is by means of a card-clothed cylinder U, Fig. 35A, a revolving brush V, and a pair of drawing-off rollers, W, which, as shown, have two positions, that in which they are operative and close to the drum, and that in which they are inoperative and indicated at Z. The unclothed division, Y, in the cylinder U, is the point where the thin layer of fibre is disrupted, and removed by the delivering rollers. Another method, in which this mechanism is not employed, consists in passing the "boards" across the web of the frame by hand, and behind the comb to be cleared, with the free ends of the fibres well gripped between their surfaces. This strips the comb, or transfers the fibre from the pins of the comb to the boards.

The first dressing, in this system of work, yields a "first-draft," the second dressing a "second-draft," and so on. Silk waste, furnishing successive drafts in which the fibre serially diminishes in length and weight of "strick," may be satisfactorily and advantageously treated to the lowest draft. Chinese "wastes" are of this class, while other sorts of "waste" drop off more suddenly in both fibre measurement and in quantity of result, and only consequently give a small number of "drafts."

As each "draft" consists of an equalized length of fibre, it was at one time the practice to treat the several "drafts" down the drawing, in the production of different qualities of silk yarn, such as from the first, second, and other consecutive "drafts." This is not now strictly done, admixtures of two or more drafts being carried out. There is not

that degree of correspondence in filament length in the respective "drafts" to establish this as a fixed economic basis of manufacture. Chinese silks, for example, will present fibre in the first "draft" of from 2½ to 6 or more inches in length, with fibre of from 1 to 3 ins. in the final "draft" made; while ordinary descriptions of "waste" result in "drafts" I, II, III, and IV, varying respectively from 2 to 6, 2 to 4, 1½ to 3½, 1½ to 3, and from ½ to 3 ins.

The flat dressing-machine described is also made in a continuous form for increasing the productive output, when it compares, in this particular, more favourably with the circular construction of dressing frame employed on the Continent. The latter, which is suitable for "Schappe" treated waste silk, comprises (1) a large drum, whose circumference is divided into three or five sections, in each of which the rods of silk are inserted and turned by the dresser and his assistant; (2) comb rollers, one on each side of the drum, and fixed in a lower position; (3) comb brushes, and (4) drawing-off rollers for clearing the circular comb. The principle of action is similar but severer on the fibre than that of the flat dressing frame, but it is found, as stated, adapted for the treatment of only partially degummed or steeped waste silk.

The dressed silk is stripped from the rods in the cylinder by placing a cloth over the surface of the rods, with the prepared fibre projecting, and affixing it to a small roller. By turning this roller, the film of silk is wound thereon, one film of combed silk linking with another from adjacent rods, and giving what is designated a "nappe" of dressed silk.

For the shorter varieties of silk fibre the Heilman combing machine may also be utilized. In principle of mechanism, and in method of adjustment and working, it is applicable to the straightening and alignment of the shortest classes of filament, and is for this reason used, to a limited extent, in the dressing of short silk wastes.

The subsequent operations may be grouped into those for long-fibre thread making, including spreading and gilling,

drawing, roving, and spinning-flyer, cap or ring practice ; and for short-fibre thread making, namely, scutching, drawing, slubbing and spinning on the ring frame. The first system of operations will be examined.

Spreading machinery is of three forms of construction known as the Open Screw Gill, the Intersecting Screw Gill, and the Rotary or Porcupine Roller Gill Spreader. The first is the older and commoner type, but is being superseded by the Intersecting Gill Box. Both the first and second types of machine agree in principle of levelling the sliver, but in the latter a second and upper set of fallers are introduced, whose pins work through the ribbon of fibres in a downward direction. The advantage derived is twofold ; the additional fallers prevent the fibres from riding on the surface of the pins, by penetrating them from above, and reduce the amount of filament leakage in the operation. The Rotary Spreader is built on the French or Continental plan, porcupine rollers taking the place of the fallers, studded with pins, and traversing on screws between the front and the back rollers of the machine.

88. *Spreading and Lap Making.*—The process will be described by referring to the illustrations (Figs. 36 and 36A) of the Intersecting Screw Gill Spreader. On the feed sheet A the dressed fibre is laid lengthways, with each spreading joining up with the preceding one, supplying a continuous and even layer of fibres to feed rollers B. These, and rollers D, have different circumferential speeds, causing the sliver of fibre to be drafted or attenuated between them. The fallers C move forward on the upper screw and travel backward on the lower screw, and the fibres, in sliver form, are, therefore, drawn through their pins by the increased speed of rollers D as compared with rollers B. There passes over the lower roller D, and a second roller adjacent to the drum of cylinder E, an endless leather belt by which the treated sliver is collected into a lap of the required thickness, when it is removed by the machine minder. Such laps are further equalized in length

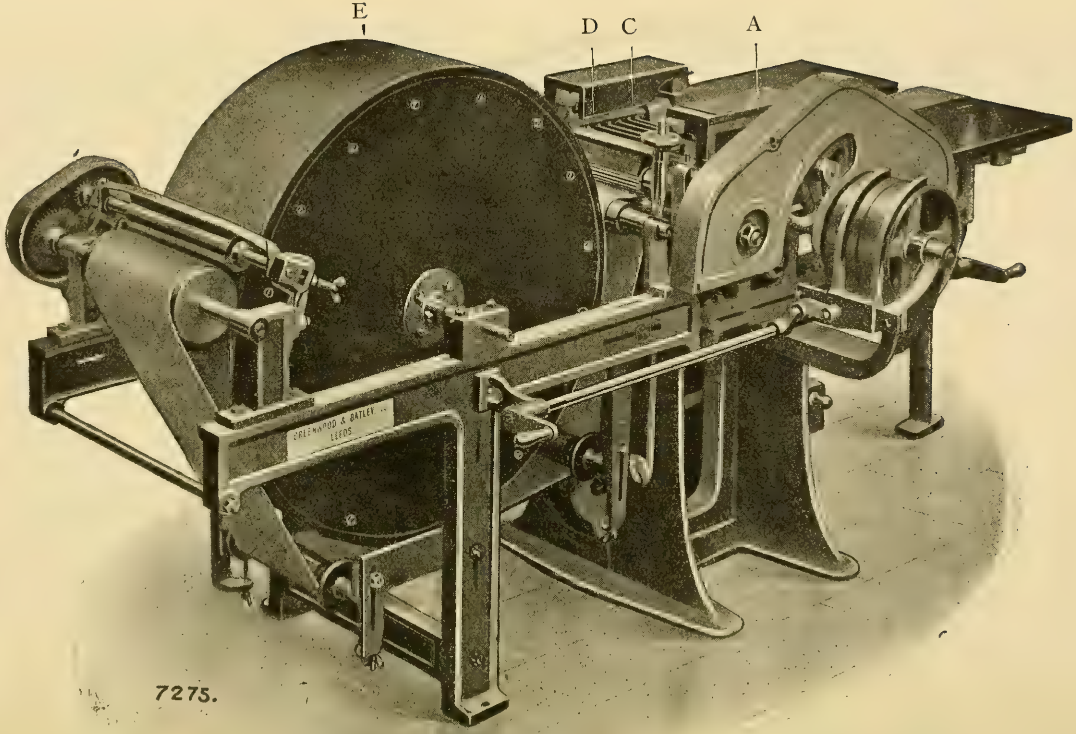


FIG. 36.—INTERSECTING SCREW GILL SPREADER.

and weight on the re-lapper, during which the blending of filament qualities, for the construction of a definite class of yarn, may be done.

The prepared lap of fibre is converted into a sliver in the Sett Frame, which is similar in arrangement to the Gill Spreader, having two pairs of rollers—back and front revolving at dissimilar speeds—and faller gills, with the addition, however, of winding-off rollers for conveying the sliver into a can.

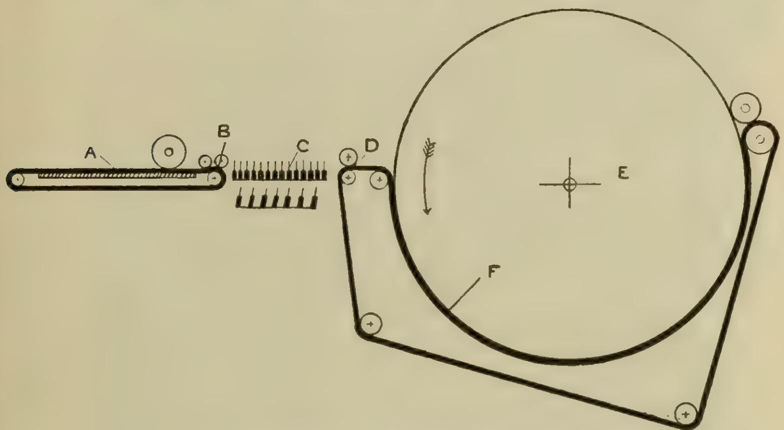


FIG. 36A.—SECTION OF SCREW GILL SPREADER.

89. *Drawing Operations.*—The silk filament is now in a suitable condition for the drawing operations. Ten or twelve cans of slivers are put behind the first head (four in number) of the Single Screw Drawing Frame (Fig. 37) and drawn out between the rollers A and B to a sliver slightly greater in length and somewhat smaller in thickness than the sliver in the series employed. Intermediate between the two sets of rollers are the usual faller gills. In the complete box, with ten or twelve slivers fed into each of the four heads, there would be respectively obtained 10,000 and 21,736 doublings of the slivers in forming one final sliver product. With this amount of amalgamation of sliver units, as well as the measure of levelling and straightening action of the fallers of each head, and also that

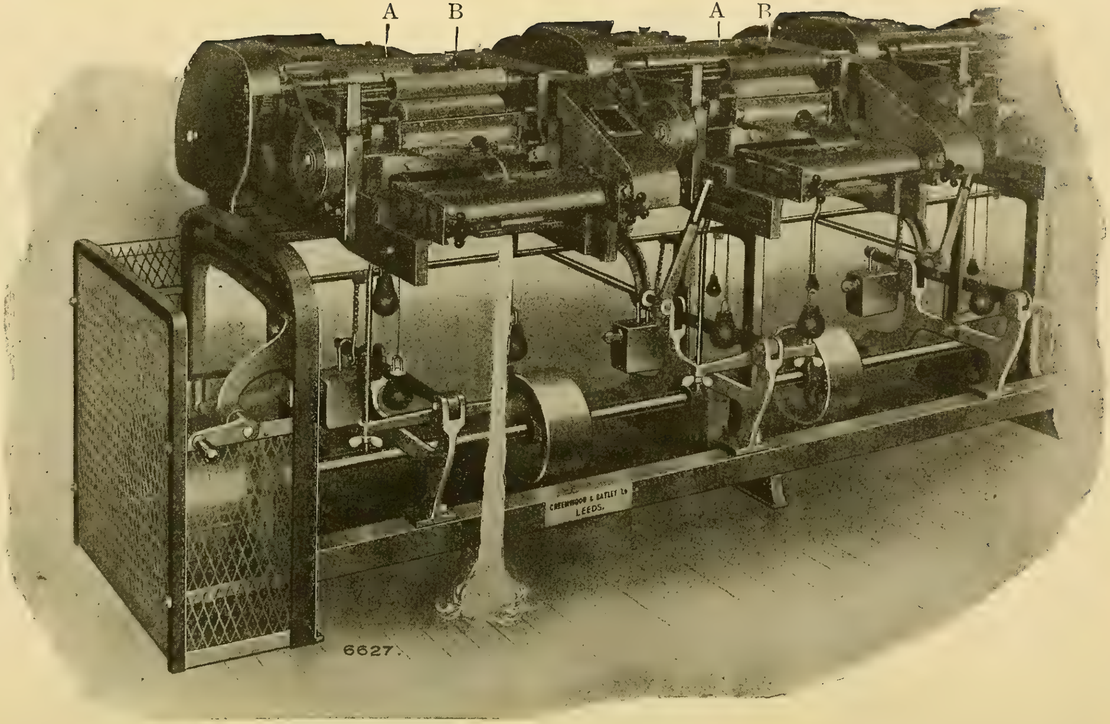


FIG. 37.—OPEN, OR SINGLE SCREW GILL DRAWING FRAME, OF FOUR HEADS, ALL ON ONE STAND AND EACH DRIVEN SEPARATELY.

of the degree of attenuation to which the slivers are subjected in passing from one pair of rollers to another, an even drawn sliver is ensured of the calculated fineness for giving the desired counts of yarn in the spinning process.

90. *Roving.*—The slivers from the last drawing box are transferred to the Gill Screw Rover for further drafting by the same complement of parts, and for winding on to a bobbin by passing the "slubbing" round a flyer and on to the bobbin. This slubbing has a definite relation in counts (weight as regards length) to the counts of the yarn to be produced, that is, the smaller the slubbing and the finer the spun thread, and *vice versa.* Some degree of twist is inserted, just sufficient to form a thread structure adapted to dandy roving and spinning. In this roving frame (Fig. 38) the gill fallers are dispensed with, but the drafting takes place as in Fig. 37, between the front and back rollers A and B, the lower roller, A^1, being positively driven, and the smaller rollers *c* being carriers. Two or three bobbins, varying with the thickness of the roving, and the counts of the roved thread to be obtained, are placed in the creel D for supplying a roving to each spindle in the frame.

91. *Spinning.*—Silk waste spinning is practicable on the self-acter (little used on account of its compound action), and on the ring, cap, and flyer frames. Flyer-frame spinning is largely practised, and is similar in principle to this form of spinning in cotton and worsted yarn manufacture.* It yields an even, a smooth, and a true thread. The cap has a higher productive capacity, the spindles being, in some classes of work, speeded up to 9,000 revolutions per minute. Ring spinning is specially suitable for yarns consisting of medium and short fibre. The method of regulating the winding and twisting, by means of "travellers" of different sizes is in its favour. The type of machine employed is illustrated in Fig. 39. The spindles are mounted in the lower frame F^1, and the "travellers" revolve on the rims of the ring frame F.

* See Chapter V in *Woollen and Worsted.*

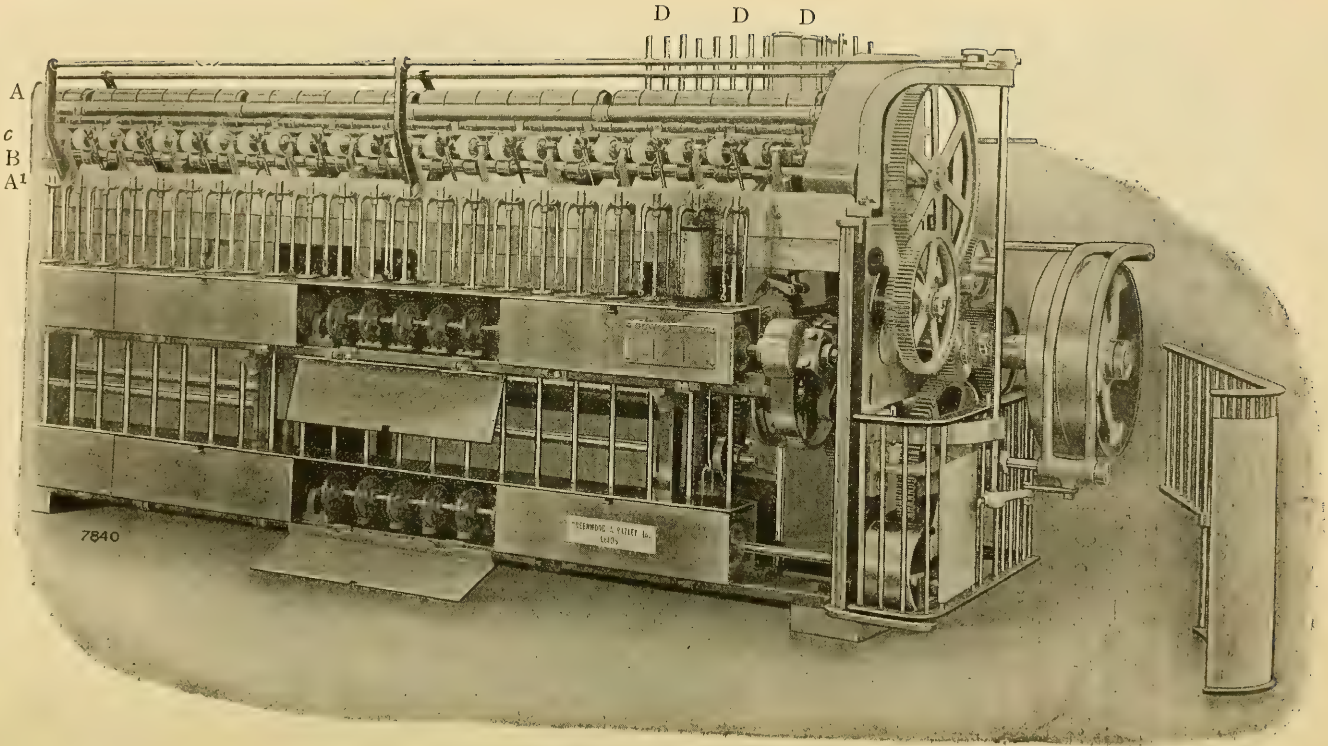


Fig. 38.—Double Roving Frame.

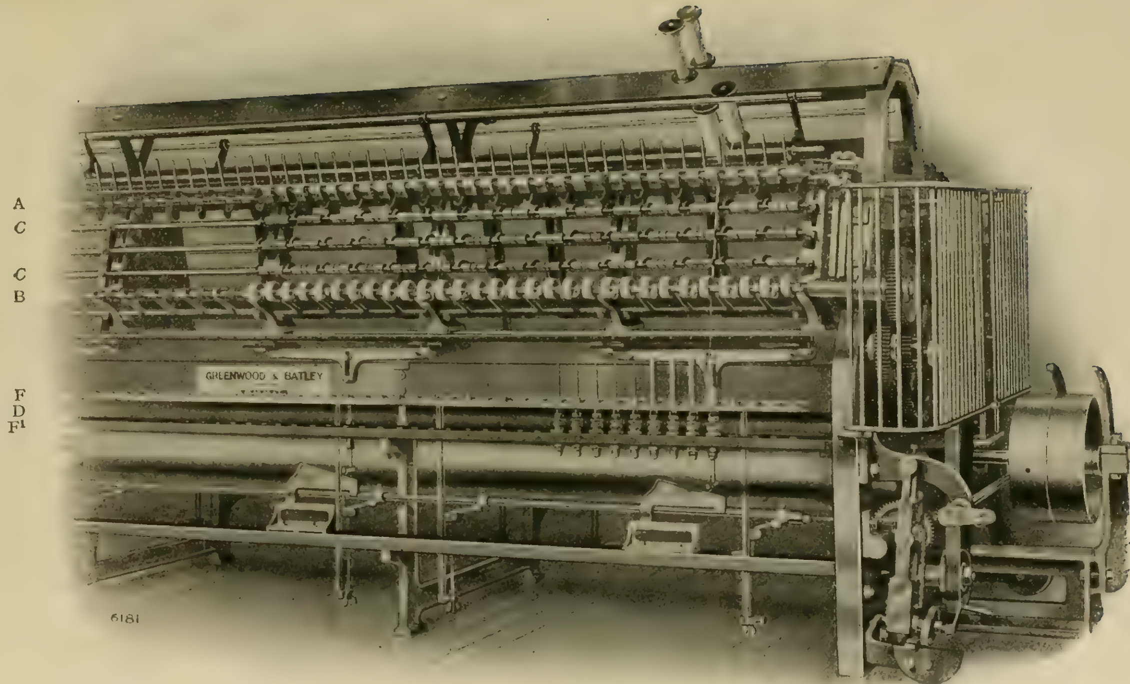


FIG. 39.—RING SPINNING FRAME.

This frame has an up-and-down traverse for distributing the yarn on to the bobbin. The driving of the spindles is done by tape or leather bands passing round the drum *c*, and the whorls of the spindles. The roving bobbins are grouped on iron pegs in the creel, the threads from which are passed separately between rollers A, the carriers C, and the front rollers B, and thence under the "travellers" on to the bobbins. The turns per inch imparted to the yarn are determined by the ratio of the yarn delivered by rollers B, and the ratio of the yarn wound on to the bobbin or spool.

92. *Gassing, Cleaning, and Lustring*.—The excellence, quality, and value of silk yarns depending on their smoothness and brightness, it is essential that all surface nibs, hairiness, and inequalities should be removed. For this purpose the spun thread is cleaned, gassed, and lustred. Gassing is the principal operation to which the yarns are, in this work, submitted. A view of the gassing machine, and also a section showing the arrangement for tensioning and gassing the threads are given in Figs. 40 and 41. The thread is taken from the bobbin D, and wrapped, as required, round the vertical cones E (see section at T), or as shown at R and S. Between the two series of cones is a bunsen gas jet F, and the path of the yarn to the winding spool is through the bunsen flame. The traverse-wound bobbin H, is driven by frictional contact with the drum K. On the breakage or discontinuance of the thread, the burner, F, is automatically moved on one side. If the yarn should be "nibby" and "hairy," and should need severer gassing, each thread is double-wrapped by being conveyed round one or more cones in both series.

Brightness of thread is further developed by treating the hanks of washed and dyed yarn in the lustring machine, consisting of a pair of hollow cylinders, one of which is heated and belt-driven. The second cylinder is constructed and fitted in the framework so that it may be carried away from the first cylinder. As the hanks of yarn are stretched between

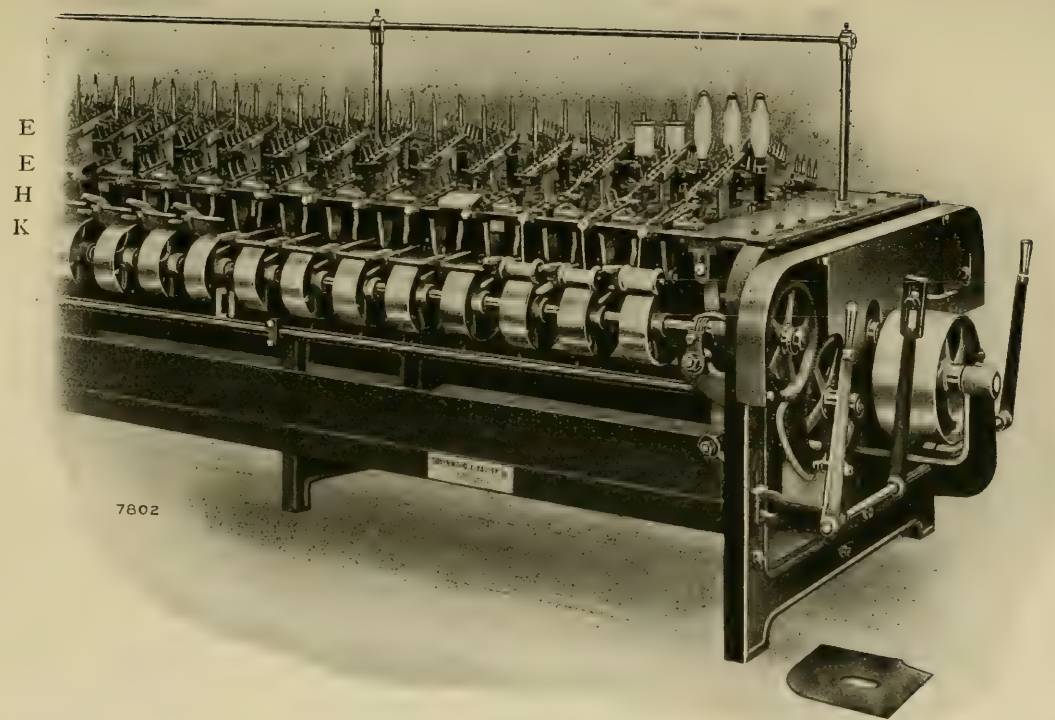


Fig. 40.—Cleaning and Gassing Frame.

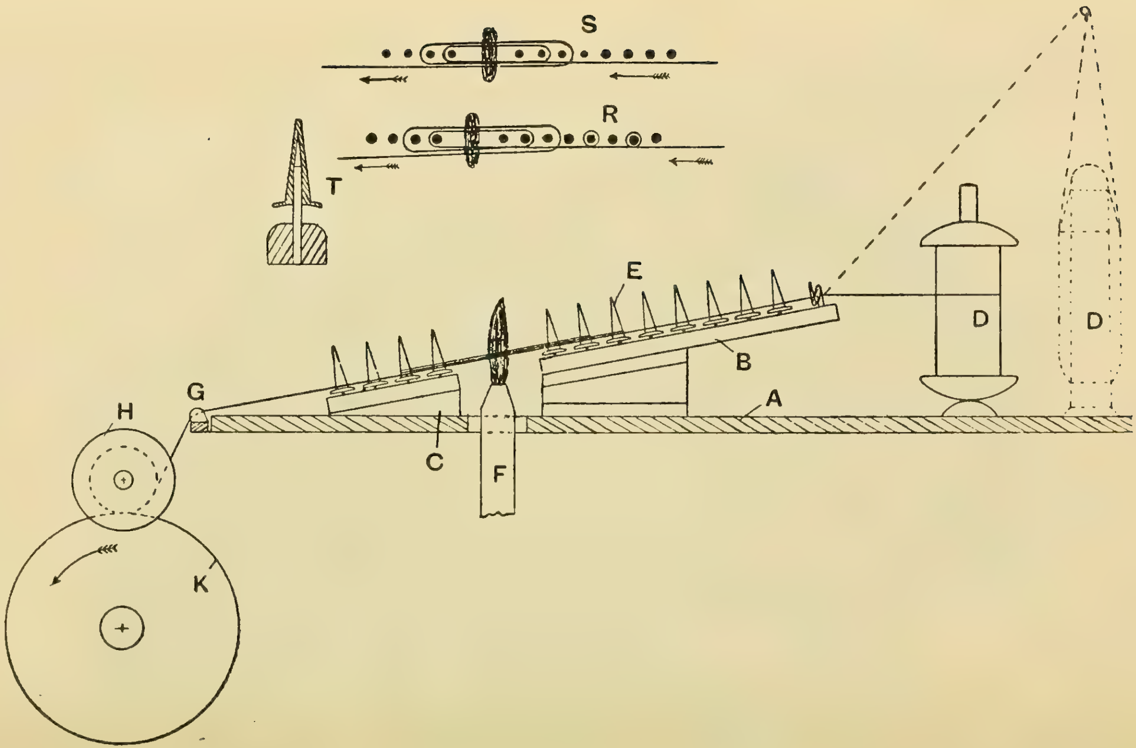


Fig. 41.—Section of Gassing Frame.

the two, the silk thread acquires increased straightness and smoothness, and improves in lustrous nature and quality.

93. *Silk Yarn Specimens.*—These include specimens of "raw" or thrown silk (Fig. 42) of "waste" or spun silk (Fig. 42A) and of artificial silk threads (Fig. 42B). The first Fig. 42, are illustrated in *organzine* (Nos. 1 to 5) and in *trame* (Nos. 1A to 5A), both in 29, 66, 132, 264, and 528 denier; the second, Fig. 42A, in folded or warp twist (Nos. 1 to 7 in 80's/2, 60's/2, 53's/2, 40's/2, 30's/2, 20's/2, and 15's/2), and in single or weft twist (Nos. 1A to 5A in 86's, 72's, 50's, 43's, and 27's counts); and the third, Fig. 42B, in warp twist (Nos. 1 to 4 in 75, 150, 250, and 500 denier), and in weft twist (Nos. 1A to 4A in the same counts); with "sized" yarns at 1B to 5B.

As the samples are reproduced to scale, they represent the actual and relative fineness and structure of the yarns in the counts quoted. The hanked samples of each yarn specimen give some idea of the lustre and diffusive properties of these three varieties of commercial silk. The artificial product possesses the higher degree of surface brilliancy; the raw silk the higher degree of textile lustre value; and the spun silk the higher degree of filament density. The lustre of the natural silk differs in quality from that of the artificial fibre. The brightness of one is rich and full, and of the other metallic, in tone. The spun yarn yields a soft species of texture, but one less distinctive in character than that producible in natural silk yarns.

Each variety of thread is employed in combination with yarns made of other classes of fibre. The super-freshness and richness of the colour of the artificial silk, render it specially valuable in the manufacture of union dress, blouse, and lining fabrics. On the other hand, for the admixture with worsted and woollen yarns, the spun silk is well adapted. The mechanical practices by which it is constructed, as well as the variable lengths and grades of filament of which it is formed, cause the yarn to present a similar structural composition as yarns made of wool, cotton, or flax. In these essentials it differs from

either natural or artificial silk yarns (with the exception of "Fibro" silk, see Par. 115), which consist of filaments running through the length of the thread, so that the latter thread structure varies with the number of filament strands—of an indefinite length measurement—combined in the processes of doubling, twisting, and winding.

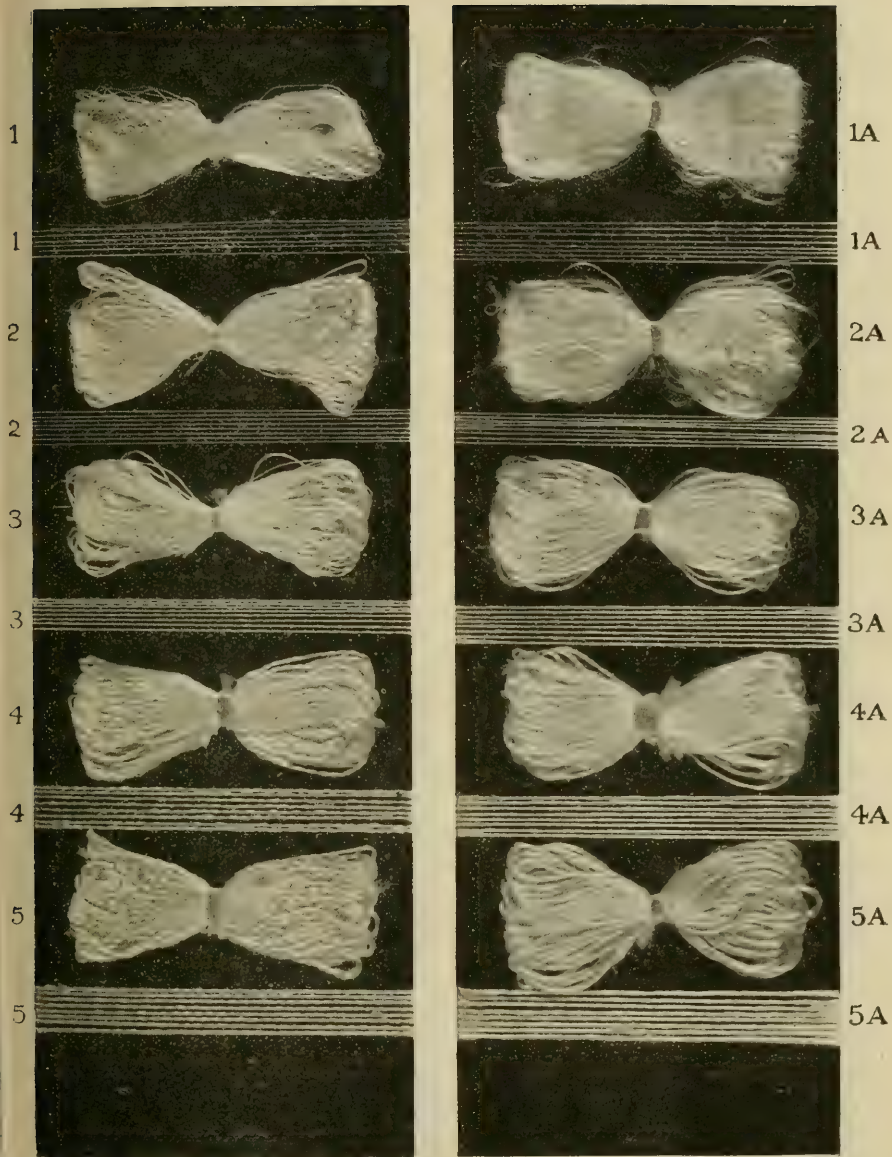
Thrown and artificial silk yarns are simple in structure, each filament used—of whatever fineness or tenuity—being of a thread-like length and formation; whereas the spun silk yarn is compound in structure, being composed of fibres of different lengths, aligned with each other, and twisted together into a continuous thread of a prescribed diameter.

The peculiar brightness of tone which natural silk imparts to the surface of a woven fabric is apparent in the decorative styles in Figs. 6, 7, and 8, and also in textures made partially of silk and partially of other yarns, in the specimens shown in Figs. 5, 19, and 21. The diffusive lustre value of artificial silk is particularly noticeable in the gauze specimen (Fig. 42C), in which shots A have a ribbon-like character, and the cotton threads, D, an evenly-rounded formation. Where, in this example, picks A bend *over* threads D they possess softness and smoothness combined with surface shimmer, and where such picks bend *under* threads D the individual fibres in the silk yarns scintillate and glitter. These qualitative textural tones obtain in all varieties of fabric in which artificial silk shots are successively floated over and under the warp yarns in the weaving process. Artificial silk yarns obviously yield textile characteristics allied with those developed in natural silk, with, however, a lesser refraction of light, and hence the brilliancy of the textures in which they occur.

Artificial Silk.*

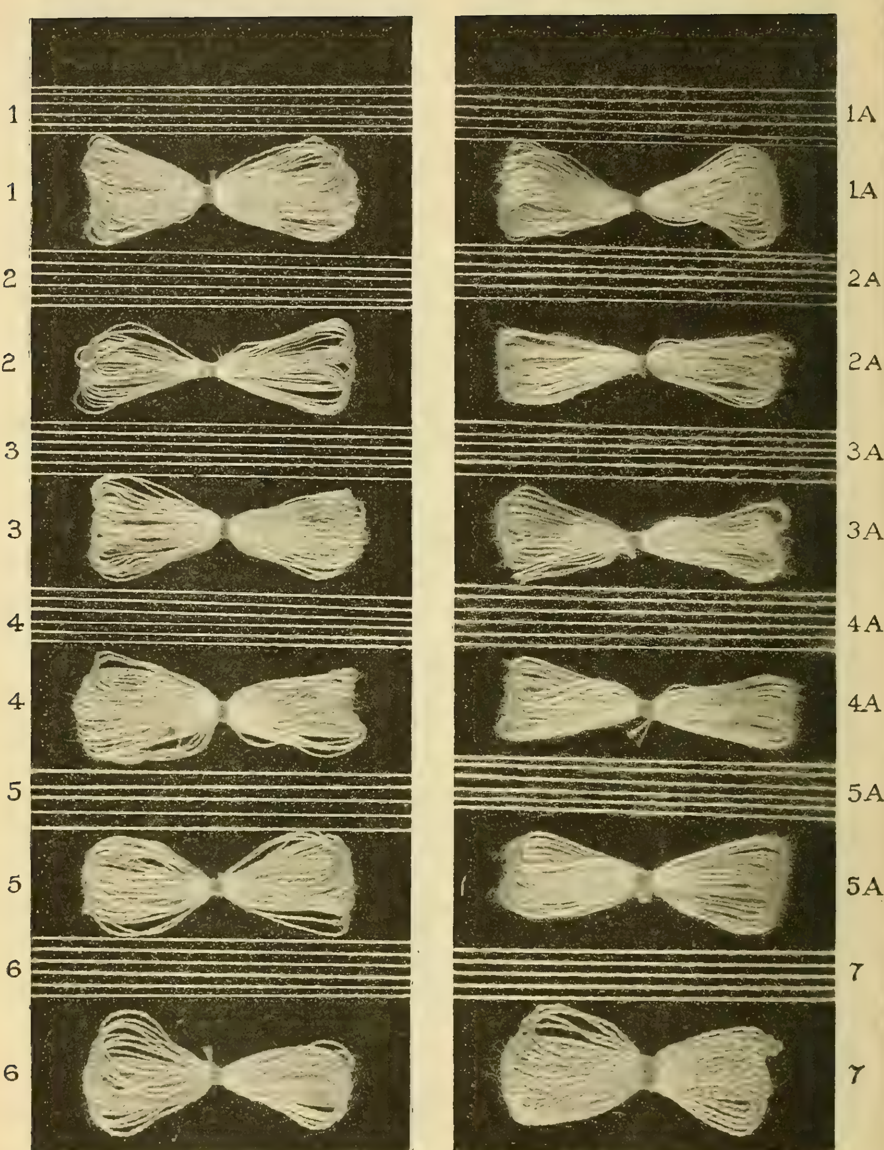
94. *The Nature of Artificial Silk.*—Artificial silk is a fibre which, in its general properties, is unique, for while like natural

* Paragraphs 94 to 117 on Artificial Silk, with Figs. 43, 44, 44A, 44B, 44C, 44D, 44E, 45, 46, and 46A, are contributed by the late Leonard Wilson, F.C.G.I., F.I.C. *See* prefatory reference.



Organzine. *Trame.*

FIG. 42.—SPECIMENS OF THROWN SILK.



Nos. 1 to 7 = Warp Twist Nos. 1A to 5A = Weft Twist.

FIG. 42A.—SPECIMENS OF SPUN SILK.

1

1

2

2

3

3

4

4

WARP·

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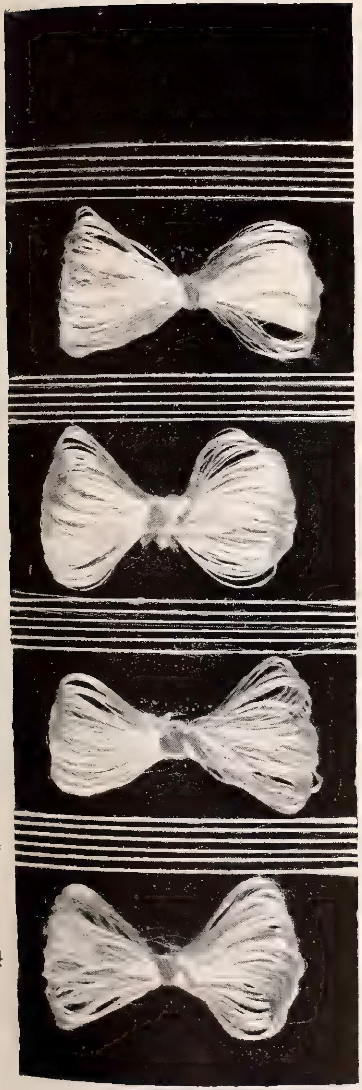
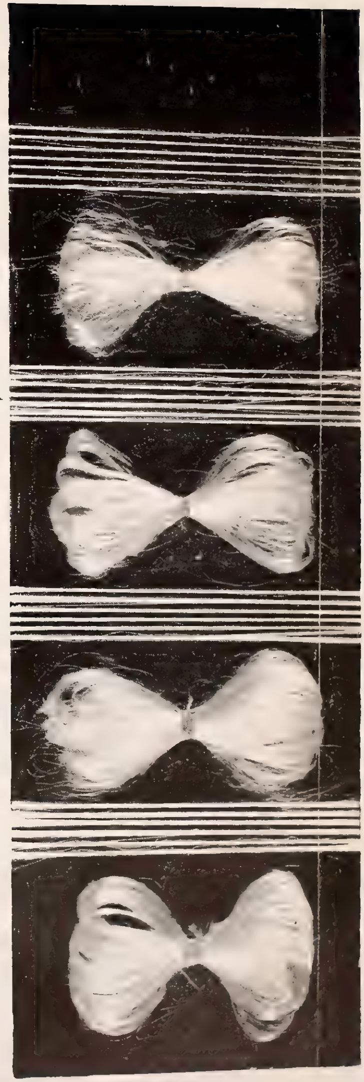


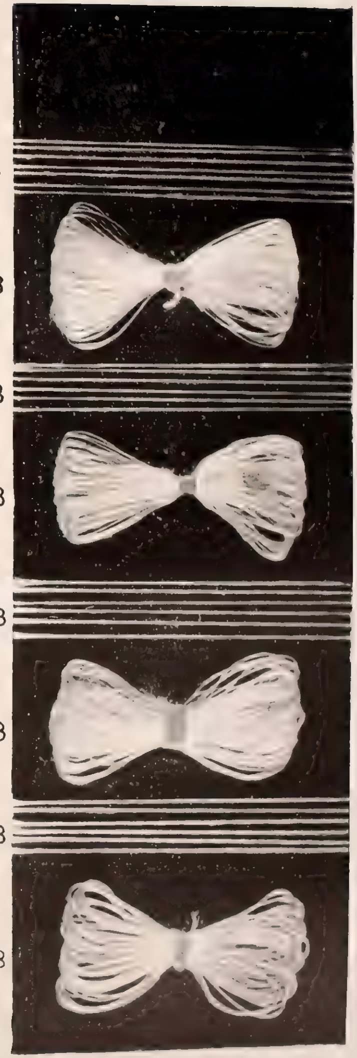
1 1 2 2 3 3 4 4

Warp-Twist Specimens.



1A 1A 2A 2A 3A 3A 4A 4A

Weft-Twist Specimens.



1B 1B 2B 2B 3B 3B 4B 4B

Sized Specimens

Fig. 42b.—Artificial Silks.

5264—(*bet. pp.* 114 *and* 115)

silk—which is of animal origin—it consists of fine filaments of indefinite length, it has none of the characteristics of an animal fibre, but instead, with the one exception of length, it has those of vegetable fibres in general, being, as at present produced, either cellulose itself or a cellulose hydrate.

In consequence, artificial silk can be used in the same manner as natural silk and treated like cotton; it produces

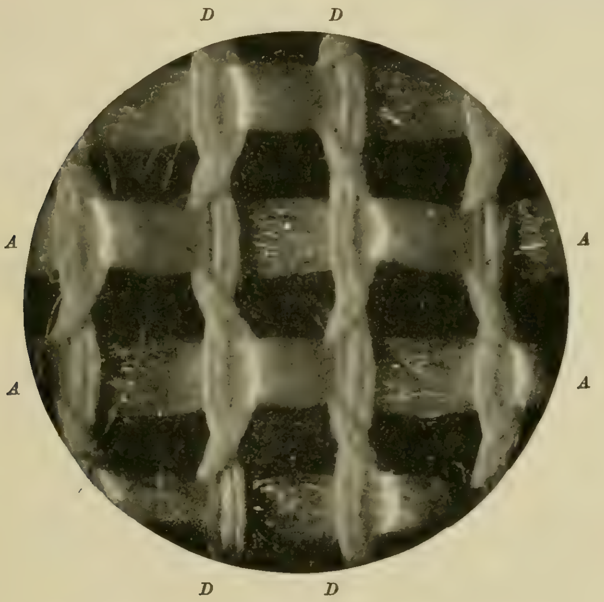


FIG. 42C.—COTTON-WARP AND ARTIFICIAL-SILK GAUZE STRUCTURE.

beautiful smooth lustrous fabrics which may be of almost any texture or weight, and when used either alone or in admixture with other fibres it may be dyed with the ease of cotton by means of either direct or vat colours.

95. *Early History and Present Production.*—The history of artificial silk dates back to the suggestion of Réaumur, made in 1734, that, just as a silkworm produces fibres from its liquid secretion, so a similar product might be made artificially from solutions of resins or gums.

This idea, however, did not materialize until about 1885 when Audemars applied for a patent for the production of silk-like threads from a solution of cellulose nitrate. During the next six years, a great deal of work on these lines was done both in this country and abroad, and, in 1891, Compte Hilaire de Chardonnet began to manufacture at Besançon about 100 lbs. a day of cellulose nitrate silk, the output from this time increasing rapidly.

The investigation which preceded and accompanied the production of silk from nitro-cellulose led, in 1890, to Despaissis taking out a patent for the use of a solution of cellulose in ammoniacal copper oxide; nothing, however, resulted from this until Pauly, in Germany, took out his first patent in 1897. Many modifications of the Cuprammonium process were proposed and employed, and it formed the basis of the commercial enterprise carried on by the Vereinigte Glanzstoff Fab. Akt. Ges. of Elberfeld.

These two processes, Nitro and Cuprammonium, each had a period of great prosperity; the Chardonnet company, for instance, paid its maximum dividend, 60 per cent., in 1905, which fell to 0 per cent. in 1909, largely due, no doubt, to the competition of the Cuprammonium process, which was then meeting with increased success and this continued up to the year before the war, when the Vereinigte Glanzstoff Fab. Akt. Ges. paid a dividend of 34 per cent.

But before this time another competing process was in the field, and just as the first was almost wholly French and the second German in inception and development, so this last—one may state with satisfaction—was British from the discovery of Cross, Bevan and Beadle that cellulose would yield a soluble xanthate, to the production of Viscose silk in Britain on the present impressive scale.

At the present time, the production of nitro-silk is very small and almost confined to Belgium; cuprammonium has a very much decreased production, while viscose has increased to such an extent that nowadays viscose silk and artificial silk are

practically synonymous. The total output of the world is probably now about 40 tons a day, Great Britain, America, France and Germany being the largest producers, while lesser amounts are manufactured in Switzerland, Austria, Belgium, Holland, Italy, Russia, Japan and Sweden.

Processes employing substances other than cellulose have been proposed, and also several for the use of cellulose compounds; none of these, however, has attained the position of a commercial fibre, although cellulose acetate silk is being experimented with on a considerable scale.

96. *The Basis Material.*—The three processes which have in turn reached the stage of being commercial successes have at least one feature in common, namely, that they consist of and have for their starting material, cellulose, the substance which forms the main portion of all vegetable fibres, and which, in other fibres, has stood the test of centuries.

In the case of both the nitro and cuprammonium processes, cotton is the form of cellulose employed, but in the viscose process—although cotton may be used—the more abundant and cheaper form of cellulose, that obtained from wood, is almost invariably used with complete success.

A short description of the manufacturing processes will bring out other points of difference.

97. *The Chardonnet Process.*—The Chardonnet process consists first of the formation of nitro-cellulose by treating cotton with a mixture of nitric and sulphuric acids, followed, after purification, by solution of the nitro-cellulose in a mixture of alcohol and ether.

This solution is formed into threads by squirting through glass jets into warm air, when the solvents rapidly evaporate leaving a solid thread which is wound on to bobbins.

The threads from a number of jets are gathered on to one roller, the whole machine being covered with a hood through which the warm air is drawn to remove the solvent from the thread. The air is subsequently cooled to recover the solvents, but this is not by any means completely achieved, and the

loss of solvent constitutes one of the chief items of expense in this process of manufacture.

In some modifications of the process, the nitro-cellulose solution is forced through jets into water which removes the solvent and forms filaments which are wound on to bobbins.

The groups of filaments from which the solvent has been removed are next twisted to form a thread; this, however, still consists of cellulose nitrate, and is extremely inflammable, subject to slow spontaneous decomposition with complete loss of strength and, further, is not readily dyed in a satisfactory manner. These defects are removed by heating in a solution of alkaline sulphide, which almost entirely denitrates the fibre leaving it in the form of cellulose, in which state it is employed for textile purposes.

This denitration considerably reduces the weight of the product and is, therefore, for two reasons, another source of considerable expense.

The nitro process is now practically obsolete except for the Chardonnet factory at Tubize in Belgium; in this country it was tried about twenty years ago at Wolston, near Rugby, but without success.

98. *The Cuprammonium Process.*—This, as has been mentioned, is almost entirely a German process, but it has been worked on a commercial scale by the British Glanzstoff Co., a company subsidiary to the Vereinigte Glanzstoff Fabriken, of Elberfeld, at Flint, North Wales, and in the Thiele modification on an experimental scale at Great Yarmouth.

It is not now carried on at either of these places, however, operations having been suspended at the latter place, and in the former transferred to the viscose process.

As in the nitro cellulose process cotton is the raw material employed for the production of Cuprammonium Silk, and is prepared by boiling under pressure with caustic soda followed by bleaching. It is then dissolved by stirring in a solution obtained by dissolving copper oxide in ammonia.

This solution is of a dark-blue colour, and, when the cotton is dissolved in it, is of great viscosity. Threads are formed from it by forcing it through fine jets generally of glass into solutions either of acid or of strong caustic alkali, the groups of filaments being wound on to glass bobbins.

The chemicals are removed by washing, and the thread is subsequently wound and twisted in the method described for nitro-cellulose. By the Thiele modification of this process, filaments of extreme fineness are obtained by drawing out during the coagulating stage.

Owing to high prices of both copper and ammonia, of which the recovery is by no means complete, this process is relatively expensive compared with the later viscose process which has very largely supplanted it.

99. *The Viscose Process.*—The Viscose process is, as we have said, the British contribution to artificial silk development and one of its important differences from other processes is that it starts with wood pulp as a raw material.

This wood pulp is specially prepared from spruce by the sulphite process and is then converted by means of caustic soda into alkali cellulose. Then follows a treatment with carbon bisulphide which converts it into cellulose xanthate; this is dissolved in water forming a thick solution, which, after careful filtration to remove any undissolved portions, is forced through platinum jets into acid solutions.

Each of these jets is perforated by a number of holes corresponding to the number of filaments which are to form the ultimate thread.

On meeting the acid solution, the xanthate is decomposed and filaments of cellulose are produced. The method employed for dealing with groups of filaments at this stage is peculiar to the Viscose process and merits notice.

The filaments, after being drawn from the bath, pass over a roller and from this drop into a rapidly rotating centrifugal

box, the filaments are thus simultaneously twisted together and flung against the sides of the box where they pack into a ring or cake (Fig. 43), from which the thread is afterwards wound into skeins.

The skeins, after this, are washed free from chemicals and bleached.

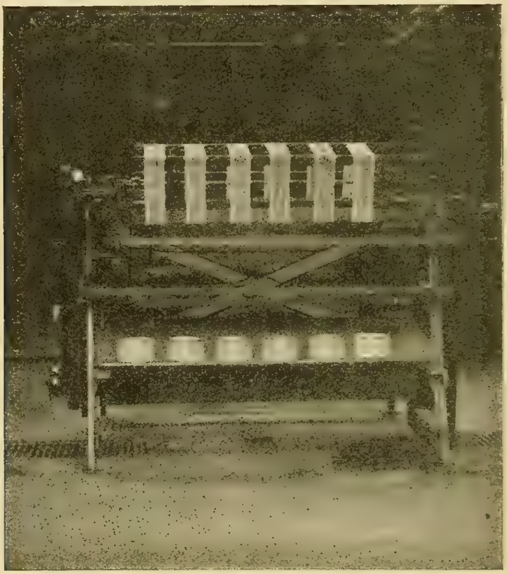


FIG. 43.—REELING FROM CAKES OF ARTIFICIAL SILK SPUN IN A TOPHAM CENTRIFUGAL BOX.

100. *The Acetate Process.*—Besides the three principal processes which have been described, there are several which have, up to the present, attained little or no commercial importance.

In some cases, an attempt has been made to use animal material and so to copy, to some extent, the composition of natural silk by means of gelatin, fibroin, and similar substances.

In others, cellulose, but in different solvents from those described, has been used, e.g. cellulose in zinc chloride or

sulphuric acid, and compounds such as cellulose formate and ethyl cellulose have also been proposed, but none of these has met with any success.

Cellulose acetate silk, however, has progressed farther than any of those mentioned, and although at present it is not obtainable in commercial quantities, preparations are being made to produce it on the large scale.

The acetate itself is formed by the action of acetic anhydride on cellulose—generally cotton—and has been largely employed for the manufacture of aeroplane dope and non-inflammable photographic films.

For the production of artificial silk it is dissolved in an organic solvent in the manner employed for nitro silk and the spinning and subsequent operations resemble this process also, except that there is nothing comparable with denitration since the acetate silk is not inflammable and the finished thread is not cellulose but a compound of this with acetic acid.

101. *Qualities.*—The qualities which have commended artificial silk—particularly viscose—to the public are, its lustre, which exceeds that of all other fibres ; its price, which is very considerably less than that of natural silk ; its excellent washing and wearing properties and the fact that it can be readily dyed in all shades and with fast colours. These characteristics have united to raise it to a unique position among textile fibres.

Artificial silk is generally classified for commercial purposes according to the thickness of the thread into deniers, which, contrary to cotton counts, rise with increased thickness of thread, the number of deniers indicating the weight in grammes of 9,000 metres of thread.

The appearance, as regards lustre and degree of whiteness, depends generally on the process employed or the factory of origin, but there is a further usually accepted standard of quality of which the highest grade is described in England as "A" quality, which indicates practically complete freedom

from broken filaments, lower grades being called "B" and "C."

102. *Distinctive Tests.*—The tests which are used to identify the products of the different processes of manufacture are mainly chemical.

The most easily distinguished is nitro silk, since the process of denitration which is used to reduce the inflammability of the Chardonnet product is never complete. The residue of nitrate which remains serves to identify the silk, which turns to a dark-blue colour when wetted with a solution of diphenylamine in strong sulphuric acid.

Viscose and cuprammonium are not so readily distinguished for both are relatively pure forms of carbohydrate, but they can be recognized by pouring a small quantity of strong sulphuric acid upon the silk to be tested. Cuprammonium threads become yellow giving in a few minutes a straw-coloured solution which afterwards becomes brown, while viscose silk turns immediately reddish-brown.

Acetate silk in strong acetic acid dissolves to a colourless solution which, on the addition of water, becomes turbid owing to the precipitation of cellulose acetate.

The differences in cross section which are mentioned in a subsequent paragraph, also assist in the identification of the various threads.

103. *Relative Properties, Tenacity, etc.*—The most important properties of artificial silk are strength, both when wet and dry, extensibility, affinity for dyestuffs, and capability of resistance to the various wet processes, such as washing, to which textiles are subjected.

The strength is measured by the weight required to break a thread of definite size, and is expressed as grammes per denier, while the extensibility is the percentage elongation which takes place before the thread breaks under the maximum load which it will carry.

The following figures represent the approximate values obtained from both the poorer and the better commercial

qualities of each of the varieties, except that, in the case of acetate, the limited number of samples available does not warrant a range of figures—

	Ten. Dry.	Ten. Wet.	Extensibility.
Nitro. Silk . . .	0·75 – 1·4	0·25 – 0·6	7·5 – 16
Cuprammonium .	1·0 – 1·35	0·35 – 0·55	14 – 18
Acetate . . .	1·1	0·7	18
Viscose	1·2 – 1·6	0·45 – 0·7	11 – 22

In order to obtain a correct figure for the tenacity when dry, the measurements must be made under standard conditions of atmospheric moisture or a correction must be made to compensate for the variation from normal conditions.

The resistance to wet treatment is measured both by the wet tenacity, i.e. the strength of the thread when thoroughly wetted with water, and by the weight of the thread which is soluble in weak caustic soda solution. With 8 per cent. caustic soda, the figures range between a solubility of 10 per cent. for a good viscose and 80 per cent. for some makes of cuprammonium.

From what has been said above it will be seen that viscose silk is in all respects at least equal to, and in most surpasses, the silk produced by other processes.

104. *Relative Textile Values.*—The textile value of artificial silk depends, in addition to those properties which have been described, on its affinity for dyestuffs and its covering power.

The affinity of silks of different makes for dyestuffs varies over a wide range, acetate silk, for instance, will not take up direct colours under normal conditions of dyeing, but absorbs basic dyes for which nitro silk also has a great affinity.

The latter, however, is a form of cellulose, of which cuprammonium and viscose silks are still more typical, and therefore these three in their general behaviour towards dyestuffs resemble cotton.

This, however, is by no means a complete statement with regard to the matter, for there is often a great difference in

the amounts of dye taken up by two varieties of silk if they are dyed together and direct colours generally are more readily dyed upon viscose than upon cuprammonium or nitro silk.

The covering power of artificial silk is dependent chiefly upon the surface possessed by a given weight of thread, and this again upon the relation between the length of the periphery and the area of the cross section of the individual filaments of the thread.

As regards the size of the filaments the cover increases as the size decreases in proportion to the diameter of the filaments, so that of two threads of the same denier, one with eighteen filaments and the other with thirty, the latter would have about 29 per cent. more cover than the former, i.e. $\sqrt{\frac{30}{18}} = 1{\cdot}29$.

The weight of the filaments, however, is not the only factor nor does the specific gravity of the various silks vary enough to be taken into account, but the shape of the cross section of the filaments is of great importance in this connection for since a circle is the form which has the minimum periphery for unit area, a filament with a circular section has less cover than a filament of any other shape, and the greater the departure from a round section the more effective is the covering power of the thread; also with increased surface for the reflection of light, other things being equal, there is a correspondingly increased lustre.

The bearing of these statements may be seen from the photographs (Figs. 44, 44A, 44B, 44C, 44D, and 44E) of cross sections of various types of artificial silk.

It will be observed that nitro, cuprammonium, and acetate are all of smooth outline, and that cuprammonium particularly is approximately round, while viscose is generally irregular and deeply serrated.

This is the explanation of the superior covering power of the last-mentioned silk, and also of its greater lustre in comparison with other artificial fibres.

The cross section of viscose silk, however, is variable over a

wide range, the controlling factors being the constitution of the cellulose xanthate and the composition of the coagulating

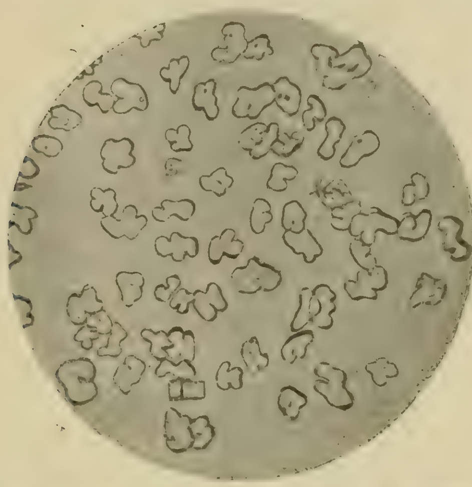


FIG. 44.—ARTIFICIAL SILK—NITRO SPECIMEN.

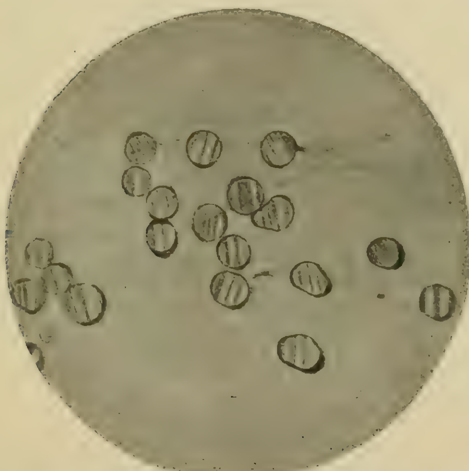


FIG. 44A.—ARTIFICIAL SILK—CUPRAMMONIUM SPECIMEN.

bath in which the threads are formed. This enables the manufacturer to choose such conditions that the thread produced is the most suitable for the purpose for which it is

intended; how widely the cross sections of viscose silk and,

Fig. 44b.—Artificial Silk—Acetate Specimen.

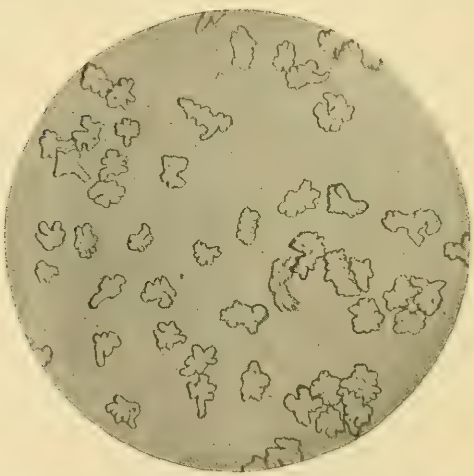


Fig. 44c.—Artificial Silk—Viscose Specimen.

therefore, its covering power and lustre may vary, are shown in the accompanying photographs, Figs. 44c, 44d and 44e.

105. *The Treatment of Artificial Silk.*—Artificial silk, when sold, is usually sufficiently bleached for all ordinary purposes,

and it is, therefore, a mistake to combine it in a fabric with unbleached fibres and then to bleach in the piece, thus

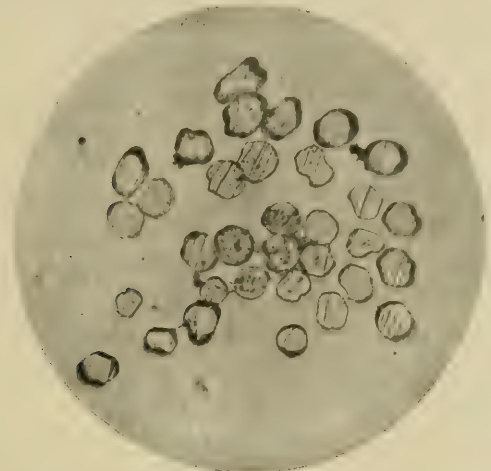


FIG. 44D.—ARTIFICIAL SILK—VISCOSE SPECIMEN.

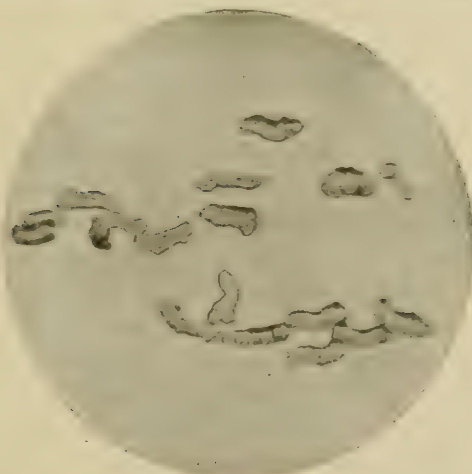


FIG. 44E.—ARTIFICIAL SILK—VISCOSE SPECIMEN.

subjecting the silk to a second and excessive treatment. Oxidation and partial destruction of the thread frequently result and, in some cases where this method has been employed,

as much as 30 per cent. of the silk has been lost and the remainder very much weakened.

In the exceptional circumstances where a second bleaching is essential, it should be restricted to the minimum amount and carried out in a bath of sodium hypochlorite containing not more than 0·1 per cent. chlorine. The bath should not have an acid reaction and its temperature should not exceed 20° C.

Artificial silk should never be subjected to hot alkaline treatment as this causes the partial solution of the fibres ; viscose silk, however, resists such a treatment to a greater extent than the other varieties, as has been mentioned when discussing the properties of the different types. An alkaline water should not be used for finishing as this results in thread of inferior colour.

106. *Dyeing.*—Artificial silk may be said, on the whole, to dye like cotton, but this statement is too wide to be true in all respects. Nitro silk, for instance, has a considerable affinity for basic dyestuffs without mordanting, in addition to its normal affinity for direct cotton colours ; cuprammonium and viscose, like cotton, require a mordant for the fixation of basic colours, but have a good affinity for direct colours and for the vat colours commonly used for cotton ; untreated cellulose acetate has, under ordinary dyeing conditions, very slight affinity for any of the cotton colours, but takes up basic colours readily.

The direct cotton colours, owing to their wide range of shade, ease of application and fastness, are the most commonly employed, and the general instructions issued by dye manufacturers for the dyeing of cotton are applicable to artificial silk also, but sodium sulphate is recommended in preference to other assistants, and the temperature of 65° C., which has been regarded as the highest permissible for artificial silk may, where necessary, be exceeded and even 90° C. may be used with advantage as, with some dyes, more even results are thus obtained.

For an even shade throughout a batch or piece of artificial silk in such cases the dyebath should be heated up to the temperature at which dyeing is to take place before immersing the material, and not heated up after the material has been entered as is the common practice.

When fastness greater than that of the direct cotton colours is required, sulphur dyestuffs may be used with advantage; these dyes are not quite so simple in application, nor can the brightest shades be obtained from them, but their resistance to both light and washing entitles them to a more extended use than they have at present.

For fabrics which have to withstand laundry treatment there is no class of colours equal to the indanthrenes, in which may be obtained brighter shades than in the sulphur dyes and superior fastness which will, in the majority of cases, even resist a chlorine bleach.

107 *Sizing, Soft Finishes, etc.*—Sizing is, in many instances, essential to the successful weaving of artificial silk, in order that the filaments may be held together when in the loom.

Sizing takes place either in the hank or in the warp; in the latter case, a special machine is employed which will size, dry, and beam in one operation. Whether sizing is carried out in the hank or in the warp, the results depend both on the method of application and the material employed, the latter being generally either gelatine or a form of starch.

Whatever the adhesive employed it should be carefully ascertained that it gives a neutral solution, as the drying of thread containing either acid or alkali is very detrimental to its quality and particularly to its strength. Soluble starches which are sold under numerous fancy names are the worst offenders in this respect, since they are frequently produced by heating starch with acid which, owing to indifferent after-treatment, is allowed to remain in the finished product.

The temperature of the sizing solution affects its viscosity to a considerable extent, and the amount of size which a thread holds is dependent therefore on the temperature of

the bath as well as its strength; when machine sizing a warp, a thinner solution is necessary than when sizing in the hank, in order that the threads may be separate on the beam.

Sometimes a soft finish is required for artificial silk, and for obtaining this, an emulsion of pure soap and oleic acid is most satisfactory. This can be made by adding 21 lbs. of caustic soda solution of 3 per cent. strength to 10 lbs. of oleic acid, and stirring vigorously until a perfectly smooth cream is obtained; a mechanical mixer is almost essential for this operation, which should be continued for at least three hours, and which results in a mixture of equal parts of soap and free oleic acid.

For use, 16 to 20 lbs. of the emulsion are dissolved in 100 gallons of water at a temperature of 35° C., the water employed for the solution being previously softened, as otherwise the lustre of the silk will be reduced.

108. *Storage and Effect of Moisture.*—In common with all other fibres, artificial silk absorbs moisture from the atmosphere, and this, under normal conditions, amounts to about 11 per cent. of the weight of the thread.

If, however, the silk is stored in a damp place, this amount of moisture will be considerably increased and the strength of the thread temporarily reduced, while its extensibility will become greater. Thread used in this damp state will probably behave in an irregular manner and cause faults in the cloth owing to variations in the amount of contraction on drying.

In the case of sized silk there is an additional reason for considering storage conditions, for it should be remembered that starch and gelatine rapidly deteriorate if not kept dry, and on this account, sized materials which have to be stored—for example, warps on the beam—should be kept in a dry ventilated store-room. It has not infrequently happened that complaints have been made of sized materials which on investigation have shown that damp storage has been the only source of trouble, with the result, perhaps, that the outside

of the beam has become unsized while the inner portion is in perfect condition.

Artificial silk which has been properly finished retains its quality unchanged for a number of years, but should it contain impurities which are either alkaline or acid, a deteriorating effect is produced, and the silk becomes both tender and discoloured; this has sometimes in the past been a serious defect in the case of nitro silk, of which some specimens have developed acid and eventually crumbled to powder.

Variations in the amount of atmospheric moisture must be guarded against not only during storage, but also during the subsequent working of the thread. The cooling of the atmosphere during the night and the consequent approach to saturation, will cause a warp left in the loom to absorb more moisture and to become slack, with subsequent unevenness in the cloth when woven.

109. *Winding.*—Although for most manufacturing purposes artificial silk is used in some other form than skeins, it commonly comes on to the market as skeins or hanks. The reasons for this are, first, that in the chief method of manufacture where viscose is spun into a Topham box, the thread is reeled direct into skeins from the cakes formed in the box; second, for any after-treatment, such as dyeing, softening or sizing, the skein is usually the most convenient form to handle and lastly, for packing or carriage it is the form which occupies the least space.

As a first step towards using thread which is in the skein form, it is almost invariably wound on to small wooden bobbins on machines similar to those used for winding silk. The skein is placed on a swift which is supported in such a way that it is free to run on its axle and above it the bobbin is fixed on a spindle by means of either a screw or spring, the spindle being driven by friction from the face of a wheel carried by a horizontal shaft.

If the thread sticks, a frequent occurrence when winding dyed yarn from the swift, the pull of the thread is sufficient

to prevent the rotation of the bobbin until the winder is able to release the skein, this arrangement reducing to a minimum the number of breakages and consequent knots.

The thread is led on to the bobbin by guides, which should be of smooth stone ware or glass to prevent breakage of the filaments, and they should be so arranged that the thread winds on to the bobbin without running up the sides.

In the cuprammonium, nitro-cellulose, and acetate processes, the thread is wound from the glass bobbin, on to which it is drawn when first formed on to smaller wooden ones without being twisted; these are then mounted on vertical spindles driven at a high speed, and from them the thread is drawn on to other bobbins so that it is simultaneously twisted and wound.

110. *Spooling.*—It is essential that thread, when put on spools, should be wound with regular tension, and, for this reason, it cannot be done direct from the skein as the pull of the swifts is variable; the thread therefore must be wound on the spool from bobbins.

In order to obtain regular tension the spindle on which the bobbin is carried runs against a weighted friction brake and the thread passes to the spool over a tension spring and through a guide eye. All obstructions, such as knots, which would prevent the thread leaving the spool freely in the loom, must be avoided, as anything which prevents free running will cause tight picks and bright lines in the weaving.

111. *Twisting.*—Like those of all other textile fibres, the filaments of artificial silk require to be twisted together into thread units before they can be used for weaving purposes, and it was formerly the practice to give the warp an additional twist, i.e. several more turns to the inch than weft thread.

As, however, increased twist has the effect of reducing lustre this practice has almost ceased, and the twist of two and a half to three turns per inch given in the viscose process to the thread as it enters the Topham box, is employed both for warp

and weft. Instead of the filaments of the warp thread being held together by extra twist they are sized so that they adhere sufficiently for weaving, and, when the size is removed, their soft twist gives them increased lustre.

For special purposes, there are very numerous varieties of warp twist according to the type of fabric desired, and a compound thread may be composed of two or more smaller threads twisted together to various extents. In some cases where the twist is to be dyed, it is wound directly on to reels from the throwing or twisting bobbins, so forming skeins, a method, however, which does not ensure such even twist as does twisting on to bobbins. To prevent the natural tendency of artificial silk to untwist if left dry, it is steamed before removal from the reel or bobbin.

The dyeing of twisted thread is, as a rule, not entirely satisfactory owing to incomplete penetration of the dye, with resulting lighter coloured portions in the inside of the twist; for this reason the thread is commonly dyed before twisting, although owing to the handling to which the skeins have been subjected during dyeing, they are generally more difficult to wind and so produce more waste.

112. *Warping.*—The bobbins from which a warp is to be wound should be of equal weight and size, and free from rough edges. They should be so arranged on the creel that the thread runs from all of them with equal tension and to obtain this result they must be placed so that the angle at which the thread runs is approximately the same for all the bobbins, and is such that it does not run against the bobbin flange, which would both increase the tension and tend to cause broken filaments.

Where a sized warp is required with more than 1,400 or 1,500 ends, it is, owing to the difficulty of machine sizing more than this number at once, made in several portions which are sized separately and dressed together, and the beam should be made quite hard, light beaming, however, being preferable for unsized warp.

113. *Weaving.*—The value of a fabric composed wholly or in part of artificial silk depends very greatly on the extent to which the special properties of the silk thread, namely, its lustre and freedom from broken filaments, are exhibited, and, therefore, it is of the utmost importance that these should be diminished as little as possible.

To achieve this, care is, of course, necessary in all operations but especially in weaving where the thread is subjected to greater strain and more frequent friction. To obtain the best effects, the healds should be perfectly smooth and free from obstructions ; the reed and the warp on the beam should be of the same width and the reed should be fine, flexible, and smooth ; similarly, the shuttle and the shuttle race should be quite free from defects wherever the thread comes in contact with them.

Great care must be taken to ensure an even tension upon the weft, since either slack or tight picks are serious defects with artificial silk, appearing as lines of different lustre from that of the rest of the material. To obtain a regular drag, and by this means the even tension desired, fur is commonly placed inside the shuttle.

114. *Artificial Silk in Woven Fabrics.*—Artificial silk is comparatively rarely used alone in the manufacture of materials such as are described in this book, although for tapestries, ribbons, knitted goods, and other fabrics it is employed without admixture with other fibres, giving very beautiful results ; for light dress and blouse materials, it is used both as warp and weft in conjunction with cotton, wool, and, occasionally, natural silk.

To produce woven pattern stripes in fancy voiles, it may be put in the warp with cotton, and since in this material a cotton weft is used, the percentage of artificial silk required to produce an effective pattern is often very small ; dyeing is carried out in the piece. In these and in similar cheap fabrics made with a weft stripe, it is common to find that economy in artificial silk has been carried too far, the threads, whether warp or weft,

being drawn too tight and a great deal of possible effect thus being lost.

In another class of cloth, of which "Luvisca" may be cited as an example, the warp is entirely cotton and the weft all artificial silk, striped effects being produced by coloured threads in the cotton warp, and the weaving pattern commonly adopted is arranged to keep the artificial silk chiefly on the face and the cotton on the back of the fabric. Materials of this type are eminently suitable for blouses and shirtings as, owing to their smooth surface, they resist soiling, and if made from viscose yarn they will be unharmed by frequent laundering.

These, and the crêpes, poplins, and numerous other fabrics into which artificial silk enters, together with other fibres, will be described in detail in another chapter.

115. "*Fibro.*"—Artificial silk has recently come on to the market in a new form which, although unaltered in its chemical characteristics, enlarges the field of its usefulness. Fibro, as the new product is called, is a viscose fibre, but instead of being a twisted thread composed of filaments of indefinite length, it consists of short fibres a few inches long which are spun into yarn by the various methods employed for the natural short textile fibres, particularly wool.

The filaments are considerably finer than is usual with artificial silk, but are of equal lustre and resemble it in all its other properties, and, therefore, the new fibre affords a means of obtaining, in types of cloth which have hitherto been composed chiefly of wool, new effects with increased brilliance and lustre by using it either alone or in admixture.

116. *Defects in Fabrics* (Figs 45, 46 and 46A).—The defects which occur in woven artificial silk materials may be divided into two classes: those caused by the silk, and those due to the methods by which it has been treated.

It is not always, however, a simple matter to determine to what cause a defect is due: for instance, a fabric may contain many broken filaments and have a fluffy appearance, and this result be due either to subjecting a yarn of good quality to

excessive tension, or to the use of a yarn the individual filaments of which varied greatly in size, a defect not uncommon

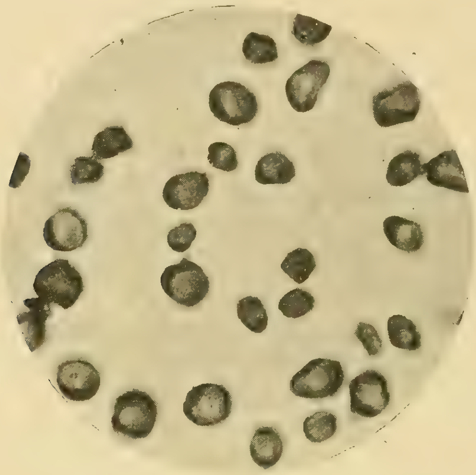


FIG. 45.—DYED VISCOSE SILK.

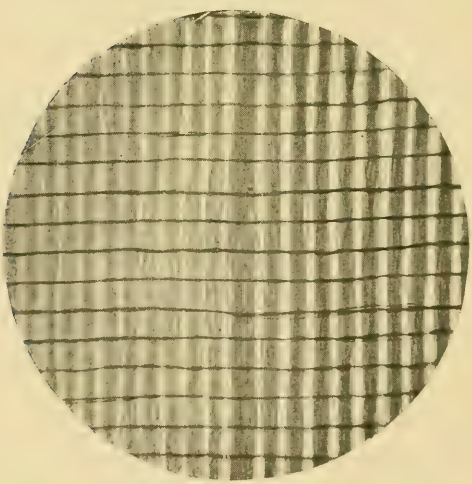


FIG. 46.—FABRIC SHOWING VARIATION IN NITRO SILK WEFT.

in some Continental makes of artificial silk, with the result that reasonably moderate tension caused the breakage of the finer filaments while those of proper size remained undamaged.

Again, the production of bars of varying shades following the artificial silk weft of a cloth may be due to the thread having been dyed in batches which, owing to imperfect matching, are unequal in shade, or to the uneven affinity of the artificial silk for the dyestuff, or to the use by the weaver of artificial silk from different sources which would almost certainly have different rates of absorption of dye.

Other defects may be due to excessive tension, isolated

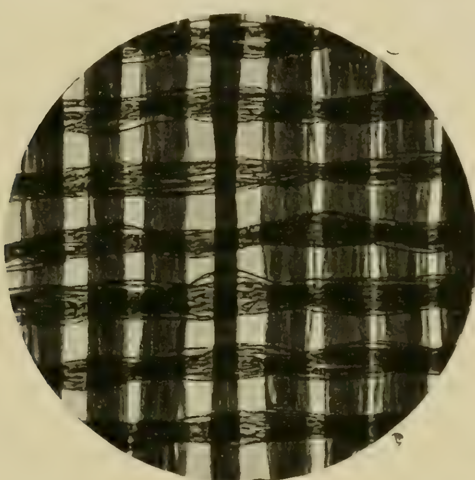


Fig. 46a.—Texture Showing Effect Produced by Threads, the Filaments of which are Stuck Together.

bright threads running through a fabric are often caused by irregularities during winding or spooling, as has been mentioned; but where a fabric contains stripes of artificial silk woven to form a design, excessive tension on all the threads of the stripe reduces to a great extent the relief of the pattern, so losing much of the possible effect. Where the artificial silk is in the weft, a similar poor result is produced by excessive stretching in the stenter, in fact it has sometimes happened that the endeavour to obtain an inch or two more in the width of the material by stretching during finishing has resulted not

only in the loss of effect but also in the extensive breakage of the weft.

117. *The Trend of Development.*—The lines of progress which are being followed in the manufacture of artificial silk are chiefly those which lead to improved qualities in the product, rather than to novelties either of form or appearance, and although a considerable amount of yarn is now manufactured with finer filament than formerly, the greatest change is to be seen in the improved properties of the product, so that particularly as regards viscose, it now has an increased tenacity both in the wet and the dry condition, an improved resistance to treatment in the wet state, and a more regular rate of absorption of dyestuffs. The result of these improvements is to be seen in the extension of the uses to which artificial silk, especially viscose, is put. Ten years ago it was chiefly employed for braids, small knitted goods, fringes, and the like, a little only being used for weaving ; now, very great quantities, limited for the moment only by the output of yarn, are used both as warp and weft, alone or mixed with other fibres, white or dyed, for all classes of cloth, from very light dress goods to heavy tapestries for upholstery, and it would hardly now be safe to say that there is any class of fabric in which, in one form or another, artificial silk could not be used with advantage.

CHAPTER IV

THE YARN UNIT APPLIED

118. *Scheme of Yarn Manufacture and Fabric Character.*—The " Yarn Unit," by reason of the nature of the fibrous or other material of which it is composed, determines the quality and style of the fabric woven. This accounts for the differentiation between cotton and silk textures when produced in the same size or diameter of yarns and with a similar number of threads and picks per inch ; or between linen, worsted or any other varieties of fabric of similar thread density, and consisting of warp and weft yarns of a corresponding thickness.

In the case of wool, the character, handle, and appearance of the fabric are also modified by the system of yarn construction adopted, such as woollen or worsted ; and, in the worsted system, by preparing and spinning the yarn on the English or on the Continental principle. The effects of the scheme of yarn construction are not so evident in the woven results in the use of other descriptions of fibre, though there are distinctions betwixt the cloths obtainable in frame and mule-spun yarns, and with cotton as the staple material. Thus two cotton textures, one made of the former type of yarn, and the other of the latter type, though the counts of warp and weft should be the same, and also the loom setting, would differ in quality and smoothness of surface. The texture made of the frame-spun yarn would be the more even, and that of the mule-spun

yarn the rougher, owing to the differences in the two varieties of thread structures. In so far as the system of yarn manufacture aims at the parallelization of the fibres in the processes of yarn preparation, the thread resultant gives the highest degree of fabric evenness which the raw material selected is capable of yielding. Similarly, in so far as the system practised intermingles all sorts of fibres in the material employed, crossing the fibres promiscuously as in carding, and forming them in a "slubbing" and yarn in this mixed relation, a thread is produced which imparts a distinctive fibrous quality to the fabric surface.

119. *Yarn Type and Textural Effects.*—It follows, if the idea in fabric construction is clearness of textural detail, whether the result of "weave" or of "colour assortment," the type of yarn to be applied is that in which the fibres are both levelled and straightened in the routine of thread-making. Should, however, the idea be a cloth soft and fibrous in character, with the fibres not only visible on the face of the texture, but with the fibres imparting fulness of handle, then the thread structure to use, of whatever material formed, is that in which the filaments are variously but homogeneously intercrossed and intersected with each other, as for example, in the carded and mule-spun cotton or woollen yarn.

120. *Silk Threads Relative to Fabric Features.* These points in yarn structure are fundamental in manufacturing work applicable to cotton, linen, worsted, woollen, and silk goods. Examining, for instance, silks (in which the effects of these distinctions in the yarns on the fabric may be said to be the least marked) it has been explained that if "waste" silk threads should not be satisfactorily cleaned and gassed, they suffer in brilliancy and smartness. A percentage of "flossy" filament adheres to the thread, and this, while in a degree rendering the texture soft and supple in the feel, detracts from the definition of the pattern details. It is not here a question of any difference in the principle of yarn making, but simply one of leaving certain fibres, which have not been

coherently formed into the yarn, on the outside of the thread. This extraneous filament proves detrimental to the smart delineation of the textural style, and affects the wearing quality of the fabric.

121. *Fineness of Silk Yarns and Weave Definition.*—The ideal silk-thread structure is one perfectly clear of external fibre, or it is one composed—as in the reeled and thrown "net" silk yarn—of fibres compactly twined together. It is,

FIG. 47.—SILK SPECIMEN ILLUSTRATION OF WEAVE STRUCTURE.* $\frac{1}{4}$-SCALE.

therefore, a yarn which closely approximates, in the effects it gives in the fabric, one made of metallic substances. Other classes of woven fabric are not comparable (Paragraph 55) in clearness of detail with those made of silk yarns. This is the more remarkable when it is considered that silk threads are the finest or smallest in diameter usable in the loom. In some fabrics the woven features are clearly pronounced as a result of the comparative thickness of the threads employed; but in silks, these qualities are solely due to the absolute evenness of the yarns. Fig. 47, a silk specimen, is illustrative of the

* See lecture on "Textile Colour Theories" in the *Textile Institute's Journal*, and given by Professor Roberts Beaumont at the Ghent Congress in 1913.

technicalities referred to. It contains 200 threads per inch, 52 denier, or equivalent to 2-fold 200's cotton, the weft being 70 denier, or equivalent to single 75's cotton. Each weave effect—weft cord in section *a*; step twill in section *b*; fine weft rib in section *c*; step twill reversed in section *d*; and warp cord in sections *e* and *f*—is clearly defined. The photographic reproduction (Fig. 47) does not adequately show the degree of weave development, but the photo-micrographic specimens (Figs. 48, 49, 50, and 51) show that the various schemes of weaving combined are all effective units in the fabric. Moreover, these microscopic analyses make it evident that it is the quality of thread formable of silk fibre which renders the diversified woven surface here acquired so distinctive in composition.

122. *Development of Detail in Woven Silks* (Figs. 48 to 51).—Examining these photo-micrographic sections (Plans *a′*, *b′*, *c′*, *d′*, *e′*, and *f′*, Fig. 47A) more closely, in the plain-rib *a* each thread is clearly traceable, and the interlacings of the threads in the formation of the fabric are also visible. When the weft, as in parts *b* and *d*, intersect with the warp threads in a varied order, the twilled characteristic, due to each shot of weft and thread of warp, is as well delineated as if produced by the crossing of metallic threads. The superior value of silk here, however, as a thread, when compared with one made of metal filaments, is particularly observed in the cord (portions *a*) where a compact weft surface is developed, with the shots of weft in such close contact with each other as to give an apparently unbroken filament surface. Metallic yarn would yield the twilled distinctions in *b* and *d*, or the thread intersections visible in *c*, but its hardness and inflexible formation would not yield the surface features seen in this and similar specimens.

The striped twill fabric in Fig. 52 (Plan 52A), on account of its comparative simplicity of construction, emphasizes, in another form, the unique adaptability of silk yarns in expressing weave features. Produced in 66 denier warp and weft,

with 160 ends and 140 shots per inch, the design is a diagonal make, angled, the formula for each pick of the diagonal being $\frac{6}{6}\frac{1}{1}\frac{1}{1}$, with the twill and plain sections formed two shots

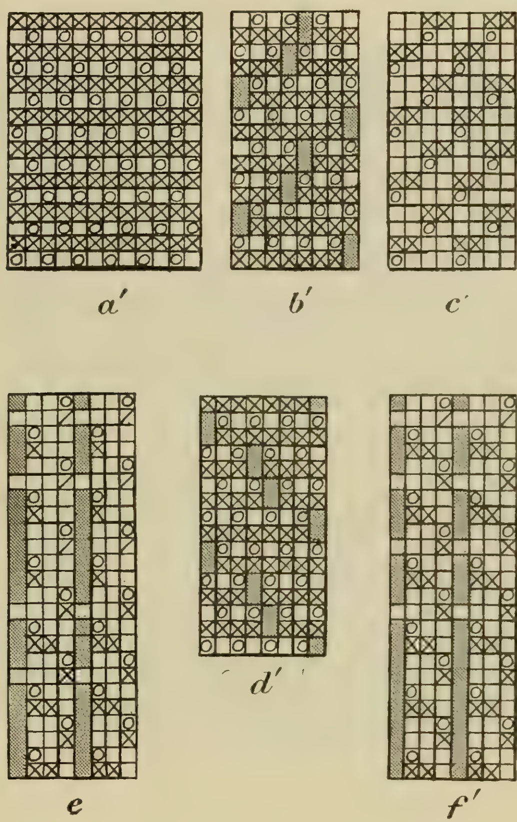
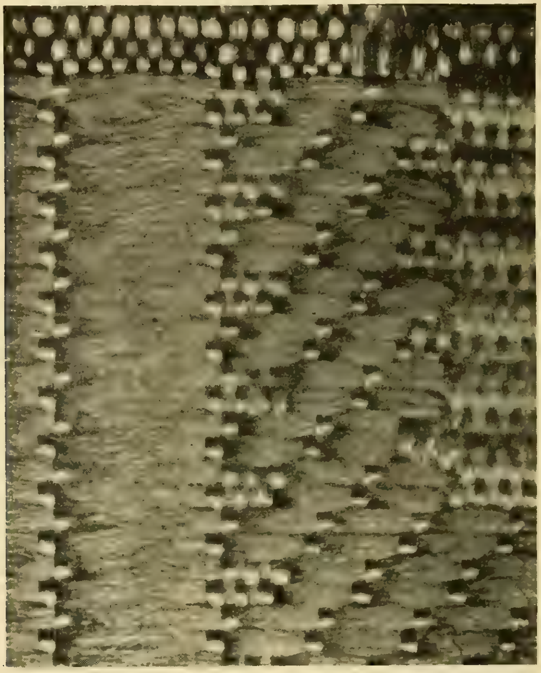


Fig. 47a.—Weave Plans for Fig. 47.

in a shed. All the weft elements are as precisely delineated in the specimen as if pen drawn. There is strictly, in this quality of Italian silk thread, no surface fibre, so that each species of interlacing in the texture is equally accentuated and rendered distinctive in character.

123. *Linen Yarns and Weave Definition.*—The technicalities

explained make it obvious that, in applying the "Yarn Unit" for the purpose of acquiring the clearest degree of textural tone and pattern development, silk is the ideal thread structure. Linen yarns, in the finer counts, give the nearest approach to silk yarns in defining weave details, as will be



a *b*

FIG. 48.

understood from examining the three linen cloths seen in Figs. 53, 54, and 55. These bleached white textures, like the silk specimen in Fig. 52, derive their pattern or structural effects purely from the plan of crossing the warp and weft yarns in the process of weaving. No contrast in colour, or variation in tint between the two sets of threads, assists in bringing out the mat or hopsack (Fig. 53), the small diagonal

(Fig. 55), or the ribbed stripe (Fig. 54). The straightness, lack of diffusiveness, and length of the flax as compared with the cotton fibre, is the cause of the smoothness, compactness, and evenness of the linen thread; and these special features of the yarn result in the more elementary, as in the more complex,

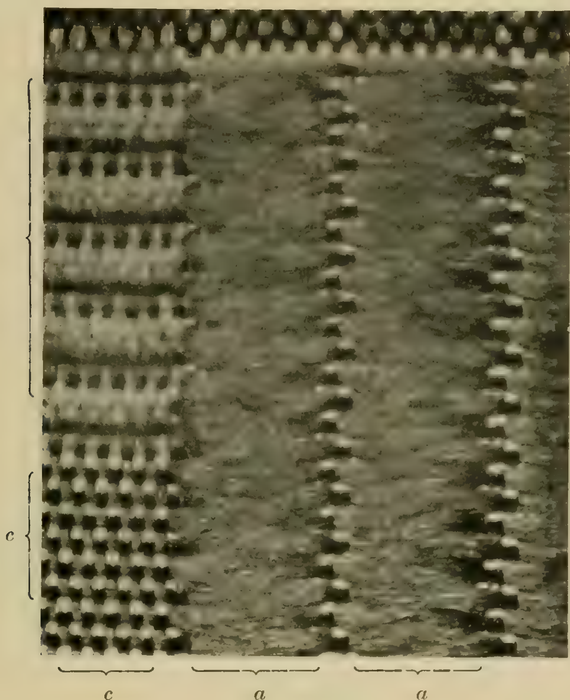


Fig. 49.

schemes of intertexture, being effectively brought out in the better varieties of linen cloths. The sheen which the fabrics acquire in the finishing and dressing, particularly in bleaching and calendering, contributes to the purity and freshness of the textural tone, but the weave definition and accentuation are in a principal degree originated by the formation of the spun yarn, for this enables structural details to be clearly

defined in unbleached or naturally dressed as in highly-finished goods.

124. *Application of Smooth and Fibrous Yarns.*—Another feature which enters into consideration is yarns made of either wool or cotton may be required to give—(*a*) clearness of fabric tone, and (*b*) a fabric possessing a fibrous face. Cloths with a soft finish—cotton or wool, flannelette in the former,

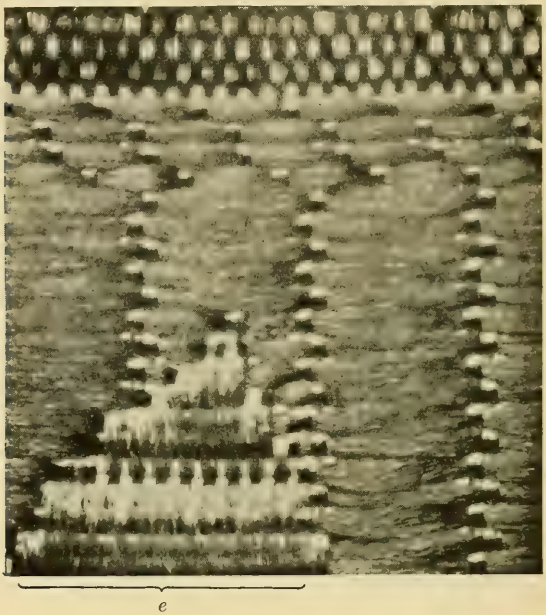


FIG. 50.

and costume fabric in the latter—are preferably obtained in yarns made on the carded principle. On the other hand, cloths, cotton or wool, with the face details clearly defined, necessitate the use of yarns in which the fibres, in the processes of thread-spinning, are combed, drawn, and frame-spun. Two types of thread, one with a clear, and the other with a more or less rough structure, are obviously producible. When selecting either one or the other for woven purposes, the nature of the fabric required has to be taken into account. The

subject may be explained by alluding to the specimens in Figs. 56 and 57, both made of worsted yarns, but French-spun in the first texture, and English-spun in the second. It will be noticed that in Fig. 56 the weave elements are subdued, while in Fig. 57 each twilled line is observed. Some degree of the fibrous character of the French-yarn cloth is due to the piece having been contracted in milling or felting from 70 ins.

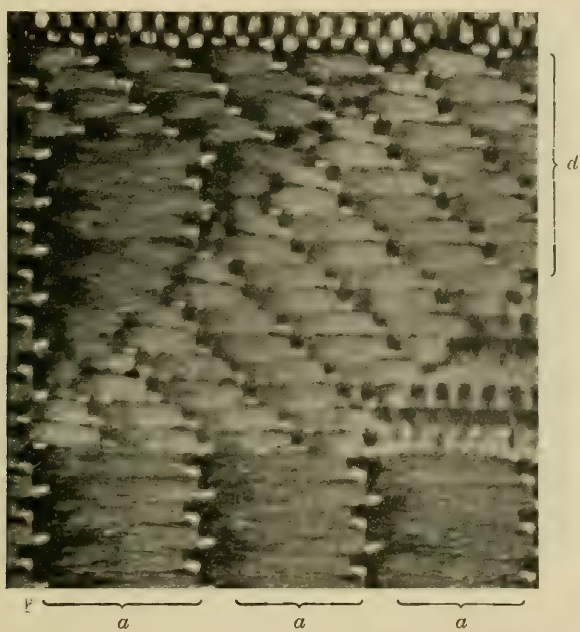


FIG. 51.

in the reed to 54 ins. finished; whereas the cloth made of English yarns has been set 63 ins. in the reed, and only shrunk in scouring. The finishing treatment, to which the two cloths were subjected after shrinkage, was, therefore, of a different character. In the English-yarn fabric, the object of the processes, especially those of brushing and cutting, was to remove all surface fibre, but in the French-spun yarn texture the fibre was brushed up, and the face of the fabric only slightly

cropped. The full filament structure of the French yarn (paragraph 48) is suitable for giving the quality of cloth here illustrated, while the smoother and more even English-spun yarn is adapted for the clear definition of the twill or pattern details, and also for making a cloth with a bright, smart face.

125. *Examples in Patterns obtained in "Foody" Yarns.*—It should be pointed out that, even in fibrous-surfaced yarns, it

FIG. 52.—ANGLED DIAGONAL—SILK TEXTURE.

is possible, by the system of cloth finishing practised, to get clearness of pattern type as seen in Figs. 58A and B. In these examples, woven in French-spun worsted and Saxony woollen yarns, distinctness of style has been acquired by raising the fibre on the face of the fabric, and following with clear cutting. The use of a "foody" quality of thread in such manufactures is valuable in producing suppleness of handle and wearing durability in the cloth. Yarns of this structure are not adapted for the type of pattern of which Fig. 68 is illustrative. The weave requires to be of a simple description—plain, twill,

or mat, and compound or double in construction. For Fig. 58A, double-plain makes have been combined, and for Fig. 58B, double-cassimere twills. One of the two plans used brings the odd threads and picks on to the face of the texture, and the other takes these threads and picks on to the back, and forms the face side of the texture in the even threads and picks. By arranging the warp and weft yarns 1-and-1 in light and

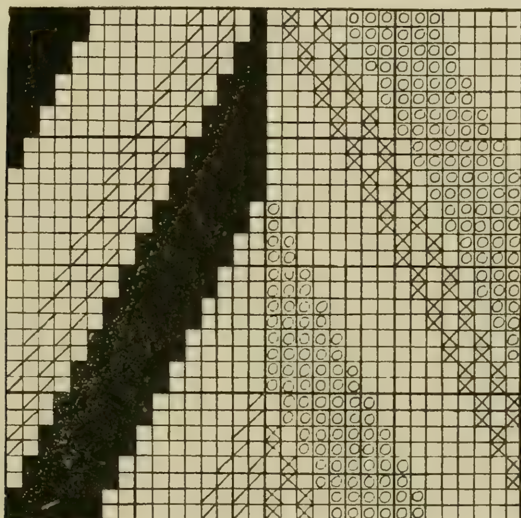


FIG. 52A.—SECTIONAL PLAN FOR FIG. 52.

dark shades, in such positions as the first of the two double-weaves is used, the pattern is developed in the light colour, and in such positions as the second double-weave is used, the effects are woven in the dark shade. It follows that by grouping two such compound or 2-ply weaves in a prescribed order they may be employed in developing any class of design—striped, checked, spotted, or figured—required ; but the effects, in all instances, are due to transposing the positions of the two shades of yarn in the warp and weft, and not to any variations in the textural plans. Both the face and the underside of the

fabric in Fig. 58A are plain woven, and in Fig. 58B twill woven—the first resembling an ordinary plain, and the second an ordinary $\frac{2}{2}$ twill texture.*

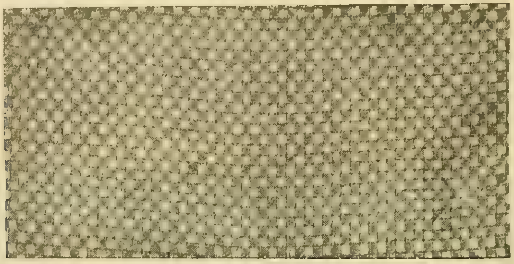
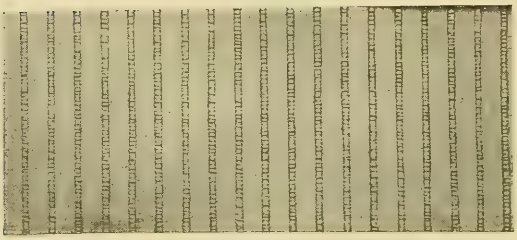


FIG. 53.



d d d d d FIG. 54. *d d d d*

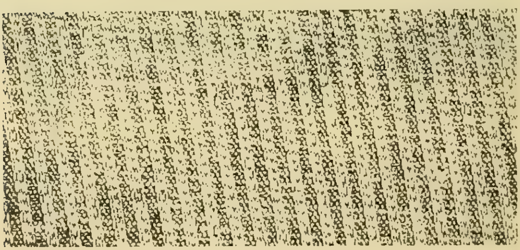


FIG. 55.

TYPES OF LINEN FABRICS.

While, therefore, yarns of a fine woollen quality may be thus utilized in the manufacture of costume fabrics, to which the schemes of patternwork observed in Fig. 58B are applicable,

* See Chapter XIII. *Colour in Woven Design.*

they are not, unless 2-fold or hard twisted, selected for textures in which weave types are produced.

The loose, entangled filament on the circumference of the carded thread (Saxony or Cheviot) subdues and partially conceals the detail effects resulting from the interlacing of the threads in a twill, mat, diagonal, or other order. On the other

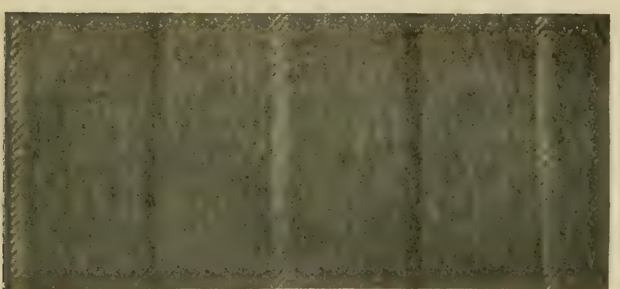


FIG. 56.

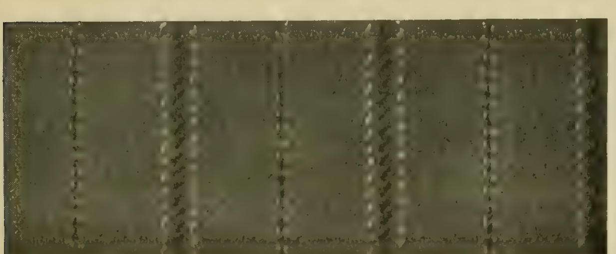


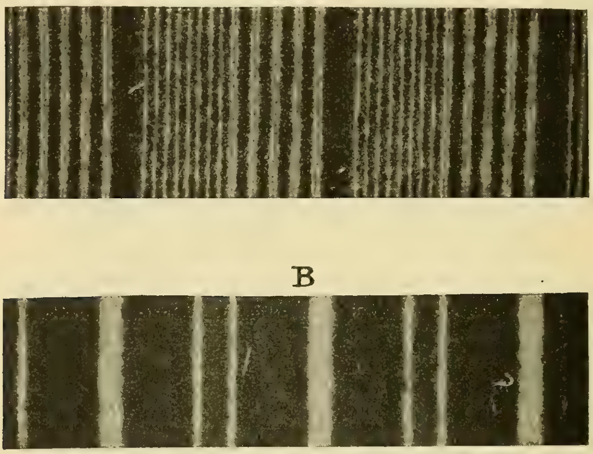
FIG. 57.
WORSTED-YARN SPECIMENS.

hand, the combed yarn (wool or cotton), and also the fine flax yarn, in which the fibres are grouped in a line with each other, as in the specimen of Botany top in Fig. 24, is the description of yarn to apply in all classes of dress goods when design definition and fabric smoothness are desiderate.

126. *Frame and Self-Actor Spun Yarns.*—The system of mechanical practice in spinning has an important influence on the weavable value and characteristics of the yarn. Frame or continuous-spun yarns (woollen or cotton) present an

evener surface than self-actor or intermittent spun yarns. The filament core and external features of the thread may not, in the operation of spinning, be radically modified. These are formed and established in the process of yarn preparation. Yet the same sliver or slubbing, when converted into yarn by self-actor and frame-spinning, gives two varieties of thread structure. This is exemplified in yarns F (Fig. 59) continuous-spun, and in yarns M, intermittent spun. Both are composed

A



B

FIG. 58.—WOOLLEN-YARN SPECIMENS.

of like materials, and made from the same counts of condensed sliver. Threads F have a less " wild " formation than threads M. Necessarily these two yarn types are not so pronounced as if one yarn had been obtained from a combed roving, and the other from a carded and condensed sliver. The minute differences between the two are, however, equivalent to having a real effect on the handle and appearance of the fabrics in which they are respectively employed. For dress goods, made of either cotton or woollen carded yarns in which filament property in the texture is desired, with the pattern softly defined, the self-actor yarn is the more suitable ; and for

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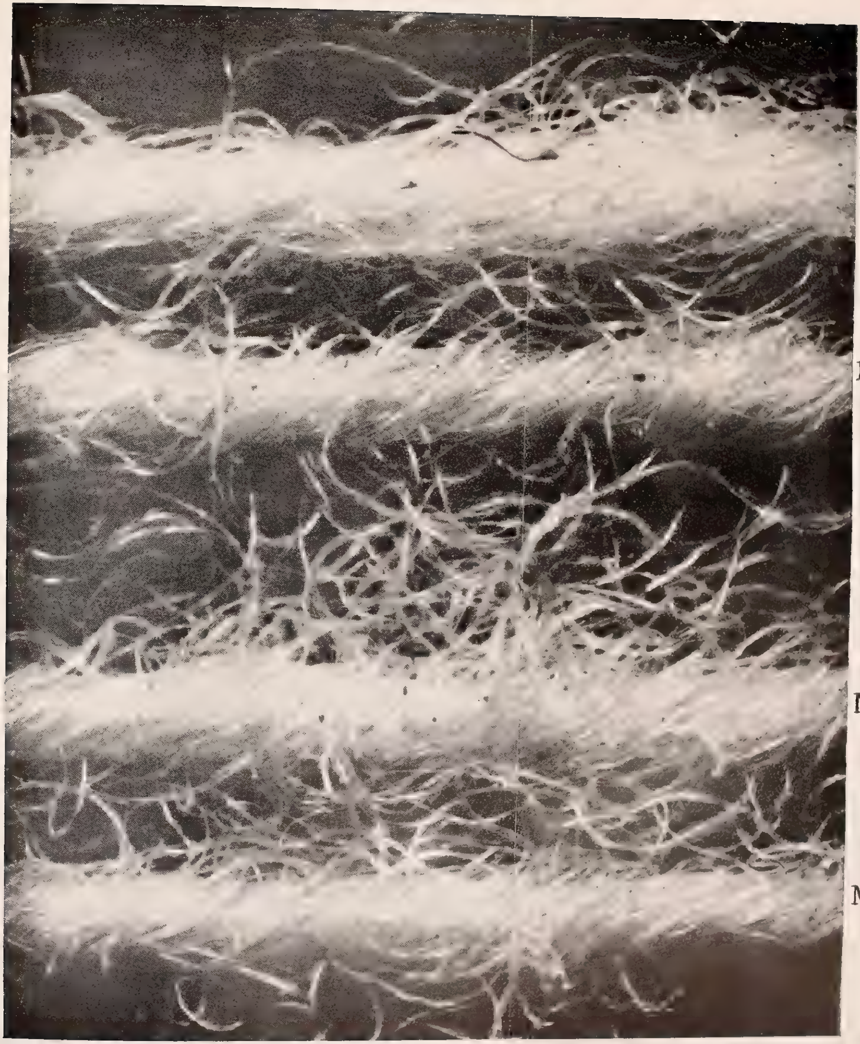

FIG. 59.—SELF-ACTOR AND FRAME SPUN YARNS.

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manufactures made of similar counts of cotton or woollen threads, in which the texture is required to have a smarter and clearer character, with the design elements better defined, the frame-spun quality of yarn is preferable.

127. *Value and Utility of the Yarn Unit in Fabric Construction.*—The thread structures and qualities dissected are suggestive of the "Yarn Unit" having the following values and applications in dress fabric design and construction—

(1) In determining the brightness, lustre, smoothness, clearness of tone, handle and quality of the finished texture, as obtainable from the variety of fibre employed.

(2) In developing differences in fabric features arising from the practice of standard systems of yarn preparation. Similar varieties of raw material, treated by carding, condensing, and self-actor spinning, give thread types of distinctive textural utility and value from the thread types produced by combing, drawing, and frame-spinning.

(3) That the smoother, leveller, and more regular the formation and circumference of the yarn, the better it is adapted for developing pattern elements acquired (*a*) by diversity of weaving scheme, and (*b*) by diversity of colouring in the warp, weft, or both warp and weft.

(4) That the denser the thread in fibre, and also the more compacted the fibres in the yarn, though the surface of the thread may be serrated and rough, the more suitable the yarn for cloths intended for diversified finishing treatment, and the softer and more supple the texture manufactured.

128. *Yarn Diameter and Fabric Types.*—In all classes of woven and knitted manufactures, the count or diameter of the yarn selected is a controlling factor, but particularly is this so in the production of dress and costume fabrics. Here the lightest descriptions of texture are made, as in muslins, crepe de chine, delaines, and gauzes. Taking costume cloths, which represent the heavier classes of dress manufactures, these rarely exceed 10 to 12 ozs. per yard, 54 in. wide. This restriction in weight range has an important bearing on the

counts of yarn used. Fabric weight is regulated by (1) threads and shots per inch, and (2) by the size or circumference measurement of the yarns applied in weaving. The common rule observed in loom-setting, or in fixing the gauge of the cloth, is the smaller the diameter of the threads, the higher the number of threads in a given area of the texture; and, inversely, the thicker the yarns, the smaller the number of threads applicable in a like area of the cloth; hence, in the finer makes of fabric, cotton, and linen, from 110 to 180 threads may be inserted per inch, and in silk brocades and damasks up to 300 or 400 threads. Ordinary makes of dress fabrics, however, such as lustres and poplins, etc., average from 60 to 101; worsteds from 32 to 80, and woollens from 16 to 44, according to the counts of yarn applied.

129 *Basic Principles of Loom-Setting.*—The basic principles of fabric structure, as observed in the plain make, the prunelle, and the $\frac{2}{2}$ twill, and in the ordinary classes of weaves produced in silk, cotton, linen, worsted, and woollen yarns, are exemplified in the Table VIII.

Looming technicalities in all classes of woven texture, have elements in common. As the yarn counts govern the ends per inch, they also affect the fineness or the openness of the make of the fabric. Seeing that every sort of spun thread is of a definite diameter, and that this diameter is ascertainable by calculation, it follows that the denominator, as stated in a fractional portion of an inch, which the diameter represents, is equal to a number of threads, which, if laid side by side, and in contact with each other, would cover an inch. To take an example, single 100's cotton, according to the rule of yarn diameters, is equivalent to $\sqrt{100 \times 840} = 261$. That is without any allowance for extraneous fibre and degree of twine in the yarn, 261 such threads, when aligned with each other, measure 1 in., or the diameter of the yarn is $\frac{1}{261}$. The intersections of the warp and weft, as comprised in a repeat of the weave, deduct from this calculated number of ends per inch. Thus, in the plain, prunelle, and 2-and-2 twill weaves

TABLE VIII

Yarn Counts and Fabric Structures

Specimen No.	A Silk and Artificial Silk Counts.	B Cotton Counts.	C Spun Silk Counts.	D Linen Counts.	E Worsted Counts.	F Woollen Counts Skeins.	G Diameters of yarn in fractional parts of 1″.	Plain Weave. Ends per inch.	Plain Weave. Picks per inch.	Wt. of Yarn per yard, 30″ × 36″.	Prunelle. Ends per inch.	Prunelle. Picks per inch.	2/2 Twill. Ends per inch.	2/2 Twill. Picks per inch.
										Ozs.				
1	28 denier organzine or trame	1/188½'s					358·3	179	179	1·1214	214·9	214·9	238·8	238·8
2	30·22 ,,	1/175's					345·2	172·6	172·6	1·1646	270·12	207·12	230	230
3	33 ,, ,,	1/160's					330·1	165	165	1·2176	198	198	220	220
4	37·7 ,, ,,	1/140's					308·9	154·4	154·4	1·3024	185·28	185·28	205·86	205·86
5	44 ,, ,,	1/120's					285·8	142·9	142·9	1·4062	171·48	171·48	190·66	190·66
6	52·8 ,, ,,	2/200's or 1/100's	100's/2 or 100's/1				261	130·5	130·5	1·541	156·6	156·6	174	174
7	66 ,, ,,	2/160's ,, 1/80's	80's/2 ,, 80's/1				233·4	116·7	116·7	1·7226	140	140	155·6	155·6
8	70·4 ,, ,,	2/150's ,, 1/75's	75's/2 ,, 75's/1	2/420's or 210's			226	113	113	1·7792	135·6	135·6	150·66	150·66
9	75·4 ,, ,,	2/140's ,, 1/70's	70's/2 ,, 70's/1	2/392's ,, 196's			218·3	109·1	109·1	1·8404	130·92	130·92	145·5	145·5
10	81·2 ,, ,,	2/130's ,, 1/65's	65's/2 ,, 65's/1	2/364's ,, 182's			210·4	105·2	105·2	1·9312	126·34	126·34	140·25	140·25
11	88 ,, ,,	2/120's ,, 1/60's	60's/2 ,, 60's/1	2/336's ,, 168's			202	101	101	1·9878	121·2	121·2	134·66	134·66
12	96 ,, ,,	2/110's ,, 1/55's	55's/2 ,, 55's/1	2/308's ,, 154's			193.5	96·7	96·7	2·0762	116·04	116·04	129	129
13	105·6 ,, ,,	2/100's ,, 1/50's	50's/2 ,, 50's/1	2/280's ,, 140's			184·55	92·27	92·27	2.178	108·72	108·72	123·06	123·06
14	117·3 ,, ,,	2/90's ,, 1/45's	45's/2 ,, 45's/1	2/252's ,, 126's			175	87·5	87·5	2·2962	105	105	116·66	116·66
15	132 ,, ,,	2/80's ,, 1/40's	40's/2 ,, 40's/1	2/224's ,, 112's	2/120's or 60's		165	82·5	82·5	2·4354	99	99	110	110
16	150·8 ,, ,,	2/70's ,, 1/35's	35's/2 ,, 35's/1	2/196's ,, 98's	2/105's ,, 52½'s		154·41	77·2	77.2	2.6048	92·64	92·64	102·94	102·94
17	176 ,, ,,	2/60's ,, 1/30's	30's/2 ,, 30's/1	2/168's ,, 84's	2/90's ,, 45's		142·95	71.5	71·5	2.8144	85·8	85·8	95·3	95·3
18	211·3 ,, ,,	2/50's ,, 1/25's	25's/2 ,, 25's/1	2/120's ,, 60's	2/75's ,, 37½'s		130·5	65.25	65.25	3·0822	78·24	78·24	87	87
19	264·1 ,, ,,	2/40's ,, 1/20's	20/'s2 ,, 20's/1	2/112's ,, 56's	2/60's ,, 30's	65·6's	116·7	58·3	58·3	3·4424	69·96	69·96	77·8	77·8
20	352 ,, ,,	2/30's ,, 1/15's	15's/2 ,, 15's/1	2/84's ,, 42's	2/45's ,, 22½'s	49·2's	101	50·5	50.5	3·9758	60·6	60·6	67·33	67·33
21	528·25 ,, ,,	2/20's ,, 1/10's	10's/2 ,, 10's1/	2/56's ,, 28's	2/30's ,, 15's	32·8's	82.5	41·25	41·25	4.8714	49·5	49·5	55	55
22	704·3 ,, ,,	2/15's ,, 1/7½'s	7½'s/2 ,, 7½'s/1	2/42's ,, 21's	2/22½'s ,, 11¼'s	24·6's	71·4	35·7	35·7	5·62	42·84	42·84	47·6	47·6
23	880·4 ,, ,,	2/12's ,, 1/6's	6's/2 ,, 6's/1	2/33·6's ,, 16·8's	2/18's ,, 9's	20's	63·9	31·9	31.9	6·2786	38·28	38·28	42·6	42·6
24	1760·8 ,, ,,	2/6's ,, 1/3's	3's/2 ,, 3's/1	2/16·8's ,, 8·4's	2/9's ,, 4½'s	9·84's	45·2	22·6	22·6	8·8964	27·12	27·12	30·13	30·13
25	5282.5 ,, ,,	2/2's ,, 1's	1's	2/5·6's ,, 2·8's	2/3's ,, 1½'s	3·28's	26.1	13	13	15·3522	15·66	15·66	17·4	17·4

quoted in Table VIII, the threads and picks per inch for 100's cotton, are—

PLAIN MAKE— $\frac{\text{261 (dia. 100's cotton)} \times \text{2 (ends or picks in weave)}}{\text{2 (intersections in weave, threads or picks)} + \text{(2 ends or picks in weave)}} = 130 \cdot 5.$

PRUNELLE TWILL— $\frac{\text{261 (dia. 100's cotton)} \times \text{3 (ends or picks in weave)}}{\text{2 (intersections in weave, threads or picks)} + \text{3 (ends or picks in weave)}} = 156 \cdot 6.$

$\frac{2}{2}$ TWILL— $\frac{\text{261 (dia. 100's cotton)} \times \text{4 (ends or picks in weave)}}{\text{2 (intersections in weave, threads or picks)} + \text{4 (ends or picks in weave)}} = 174.$

No allowance is made in these results for the true workable diameter of the yarns, which varies with the material of which the yarn consists, the diameter allowance added for silk being $2\frac{1}{2}$ per cent., cotton and linen, 5 to $7\frac{1}{2}$; worsted, $7\frac{1}{2}$ to 10; and woollen 10 to 15. These percentages reduce the possible ends per inch, or the actual diameter of the yarn for weaving purposes, but have not been taken into consideration in framing Table VIII, in which the ends and picks per inch of the respective fabrics are stated as they would approximately be in the finished texture. By allowing the different percentages named on each yarn, the loom-setting for each example could be arrived at.

130. *Elements in Practical Setting.*—In explanation of Table VIII, it should be stated that columns A, B, C, D, E, and F comprise the yarn counts, namely, silk, cotton, spun silk, linen, worsted, and woollen, or the principal sorts of yarn used in textile manufacture. Second, column G comprises the diameters of the threads in the respective counts, as acquired in all instances on the calculated basis. The adoption of this rule gives the diameters of corresponding sizes of silk, spun silk, cotton, linen, worsted and woollen yarns as identical. For example, in No. 19 the theoretical diameter is given as $\frac{1}{116 \cdot 7}$ for 264·1 denier silk, 2-fold 40's cotton, 20's 2-fold silk, 2-fold 112's linen, 2-fold 60's worsted, and 65 skeins woollen. Actually, as explained, the diameters of these several sorts of

thread, for cloth setting, would vary with the fibre of which they are composed, and also in some degree with the system of thread manufacture practised. The more level the structure of the yarn, and the harder its twine, the nearer to its calculated diameter. For practical purposes, by taking the threads per inch possible in the fabric as obtained from the diameters as representing the maximum threads per inch in the contracted or finished fabric, the comparative basis of weight calculation indicated in Table VIII would be satisfactory. The diameter of the yarn for setting in the loom, or for the average number of ends in the reed, and the shots per inch in the weaving of the fabric, requires to be increased in the ratio of the difference between (*a*) the calculated and the working diameter of the yarn, and (*b*) between the width of the contracted and loom-woven fabric. To take the counts of the yarn for specimen No. 20, with a maximum diameter of $\frac{1}{101}$, giving in the plain weave 50·5 ends and picks per inch, then, in the first place, for the loom setting, $2\frac{1}{2}$ per cent. would be allowed on the silk, 5 per cent. on the cotton, 10 per cent. on the worsted, and 15 per cent. on the woollen, and in the second place, the degree of contraction estimated or allowed between the loom and finished widths, would also be taken into account. Regarding the latter factor, it is one determined by the quality of manufacture intended. The settings illustrated are such as would give a firm or normal build of fabric; but, in practice, a flimsy, loose, or super-flexible texture, as well as a super-hard and strong texture are producible. For the loose type, the setting fixed on the yarn diameter basis, less a percentage of allowance for the production of openness of fabric structure, would be made; and hence for the firm type of fabric, the ends and picks in the loom, as determined by the rule of diameters and intersections, might be slightly increased.

131. *Thread Counts and Fabric Thickness.*—It will now be apparent that in the exact ratio in which the diameter of the warp and weft threads is diminished, the "set" of the cloth

may be increased; and, on the other hand, that in the exact ratio in which the threads are augmented in diameter, the set of the cloth may be decreased. Silk, as reeled from the cocoon, is a continuous thread, with a diameter of from $\frac{1}{1250}$ to $\frac{1}{1600}$ part of an inch; and, as shown in Paragraph 24, if applied in weaving in the natural size, would result in a plain interlaced texture of approximately 800 to 1,000 threads and shots per inch. In Table VIII, the finest silk thread specified, 28 denier, has a diameter of $\frac{1}{358 \cdot 3}$, and hence, as indicated, is weavable in a plain fabric, having 179 ends and picks per square inch. Such a texture has a weight of 1·2644 ozs. per yard. Clearly this is not the lightest woven silk structure producible; net or thrown silk may be used in smaller counts such as 20, 15, or 10 denier, with a relatively larger number of ends and picks per inch than the fabric defined in specimen No. 1 of this table. With the diminution of the size of the threads, the texture becomes more flimsy and gossamer-like in character.

Cotton and linen yarns, for special purposes, may be spun to a higher diameter than indicated, such as $\frac{1}{400}$ to $\frac{1}{500}$ part of an inch, but the commercial standards rarely surpass 2/180's cotton, and 2/490's linen for warp and weft, though in yarn tables the counts are theoretically carried out to 600's (cotton) and 1,620 (linen), or the equivalent of 8.803 denier silk.

132. *Textural Weight per Yard.*—The weight per yard of the woven product, when set on the intersection basis, rises proportionately with the size or thickness of the yarn employed. The data contained in Table VIII under this head are instructive, and need to be dealt with. Plain textures, varying from 1·1214 ozs. to 1·4062 ozs. per yard, 30 ins. wide, silk and cotton counts, are specified in 28 to 44 denier, and in 1/188's to 1/120's cotton. For textures ranging from 1·5401 ozs. to 1·7226 ozs., the counts of silk, cotton, and spun silk yarns are shown. For textures from 1·7792 to 2·2962 ozs. in silk, cotton, spun silk and linen, the counts quoted opposite examples 8 to 14 inclusive are suitable. In looming the fabrics (Nos. 1 to 14) the warp yarns would be 2-fold in cotton, spun silk, and linen, but the

number of ply in the silk would be in accordance with the quality of texture manufactured.

Analyzing these yarn counts further, it will be seen that for cloths of 2·4354 to 3·08222 ozs., worsted, as well as silk, cotton, and linen threads, are usable. Finer counts of worsted are spinnable than specified, such as 2/140's, 2/160's, up to 2/200's, but 2/120's and downwards are the commoner count bases. The equivalent to 2/60's worsted (No. 19) in woollen, is 65·5 yarns per dram. Sixty skeins and higher counts of woollen yarns have been experimentally prepared by redrafting in the process of spinning, but for ordinary practice from 44 to 48 or 50 yards per dram are the maximum. Hence, in the cloths averaging from 3·4424 to 6·2786 ozs. (Nos. 19 to 23) woollen, in addition to worsted, cotton, and linen yarns are utilized. Ordinarily, in the dress and costume trade, the extreme weight is reached in specimen 23, or as represented in a plain cloth made of 18 to 20 skeins woollen, and equivalent to about 6 ozs. per yard, 30 × 36 ins.

While the silk threads are quoted in the lower diameter of yarns, their chief utility is in the counts included in Nos. 1 to 18. Spun or waste silks may be economically employed in textures of a heavier quality than the pure or "net" silks, or in such counts as enumerated in Nos. 17 to 21, with a more general application to the type of manufacture comprised in examples 10, 11, 12, and 13.

133. *Technical Practice and Yarn Counts.*—The object in technical practice is to select and apply the yarn qualities in the counts in which they are standardized, adapting the loom setting to the weight and variety of texture desired. Silk is the kind of yarn to employ in the production of the finest and lightest fabrics. Waste silk yarn, warp and weft, are applicable to similar fabric structures as cotton and linen yarns. Cotton threads, as seen in column 2, Table VIII, to which might be added linen, provide the fullest range in cloth manufacture, inasmuch as they are suitable for the construction of the finer, the medium, and the thicker grades of fabric. The worsted

yarns, of the Botany class, are largely applied in the production of fabrics ranging in yarn counts from 2/30's to 2/120's, and of the Crossbred class, ranging from 2/12's to 2/32's, with, in both types of fabrics, either 2-fold or single yarn for weft. The woollen yarns are obviously the best adapted for the heavier sorts of costume fabrics—Saxony qualities in counts from 20's to 44 skeins ; and Cheviot qualities, in 8 to 20 yards per dram.

So far, fabrics in the plain weave only have been considered, but, in the Table VIII, settings are also given for the prunelle and the $\frac{\ \ 2}{2}$ twills. These, with the plain make, form the three standard types of weave in the dress industry. For showing how the number of interlacings in the weave unit modifies the ends and picks per inch in the texture, reference will be made to the sectional sketches of these types of woven fabric in Figs. 60, 61, and 62. Taking a group of twelve threads in each cloth, the intersections on each pick are—in Fig. 60, 12 ; in Fig. 61, 8 ; and in Fig. 62, 6. The fewer the intersections on a given number of threads, the larger the number of ends per inch possible in the loom in a given counts of yarn, which will be evident on comparing the ends per inch in the following examples from Table VIII—

No.	Diameter of the Yarn.	Plain Weave. Threads and Picks per inch.	Prunelle. Threads and Picks per inch.	$\frac{\ \ 2}{2}$ Twill. Threads and Picks per inch.
6	261	130·5	156·6	174
8	226	109·1	130·92	145·5
11	202	101	121·2	134·66
13	184·55	92·27	108·72	123·06
15	156	82·5	99	110
21	82·5	41·25	49·5	55

The ratio of intersections in the respective weaves, causes the decrease in the threads per inch in a corresponding diameter of yarn ; or in the ratio of the decrease of the intersections between the textures in Figs. 60 and 61 and between the textures in Figs. 61 and 62.

To take a further illustration, say that of the 8-shaft sateen, Fig. 63, with 3 intersections on 12 threads, and applied to 2/80's cotton, diameter $\frac{1}{165}$, it results in 132 threads per inch, as compared with 110 in the 2-and-2 twill, 99 in the prunelle, and 82·5 in the plain make, showing that as the number

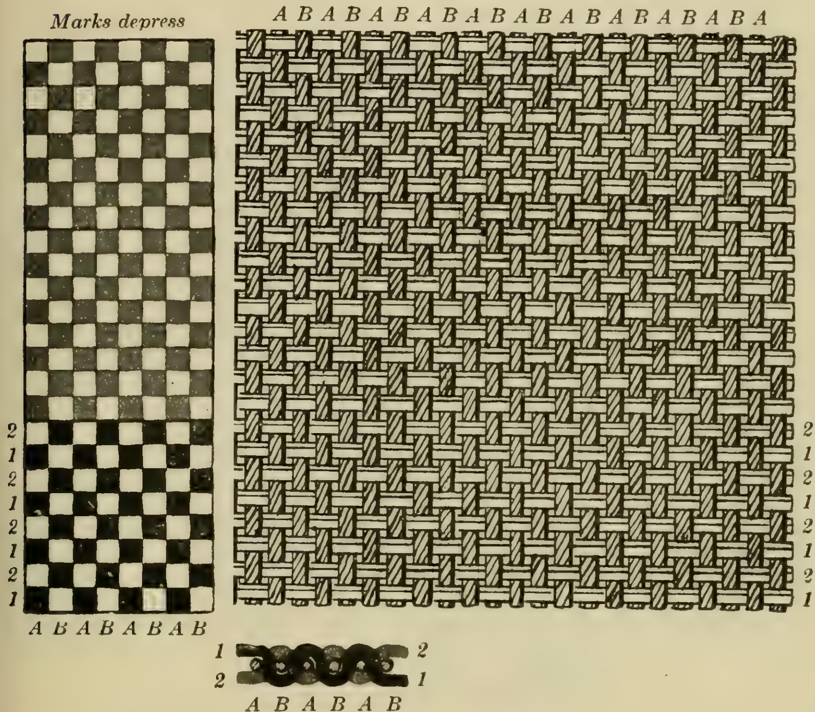


Fig. 60.—Plain Fabric Structure.

of the intersections decreases, the number of threads per inch, as represented by the diameter of the yarns, is approximately diminished. This implies that the weight per yard of the fabric in any given counts of yarn, though the setting may be correct and adopted to the weave structure, augments with the looseness of the plan of yarn interlacing.

134. *Variations in "Warp" and "Weft" Settings.*—The specimens examined have been in fabrics woven on what is

technically termed the square, that is, corresponding in ends and picks per inch. In practice this rule is greatly varied. For economic weaving, it is common for the picks inserted per inch to be less than the threads per inch in the warp. The evener and better varieties of fabric may, as a rule, be produced

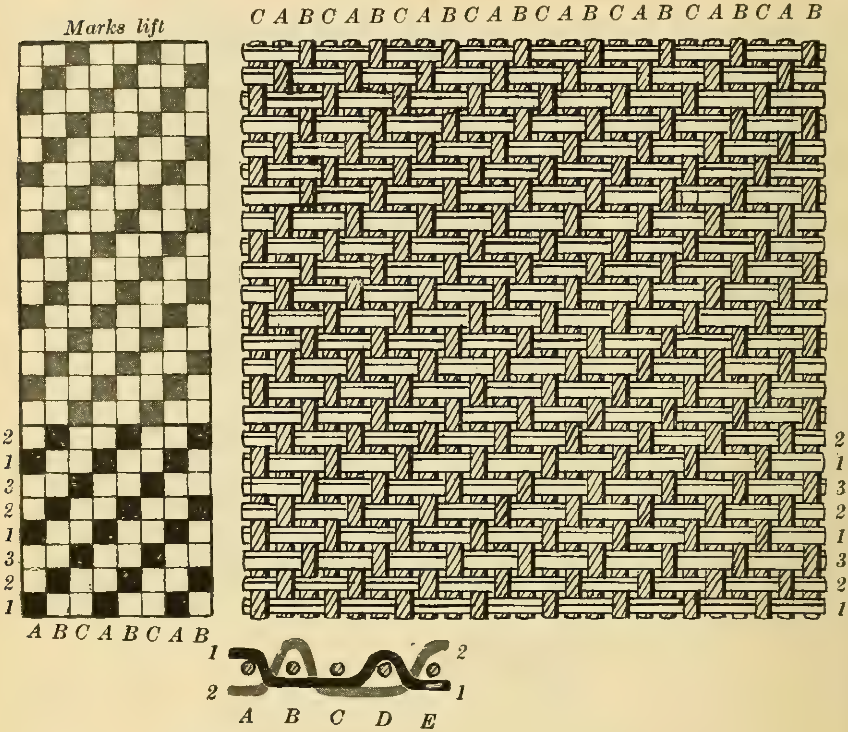


FIG. 61.—PRUNELLE TWILL FABRIC STRUCTURE.

on the basis shown in the Table, which results, when the counts of the warp yarn are the same as those of the weft yarn, in textures of an equal tensile standard, and of wearing strength, in length and width. Either a variation in the setting of the two sorts of yarn (warp and weft) or in their relative counts, alters the fabric in these characteristics. The tensile standard may be equalized, in some degree, by increasing the thickness

of the weft yarn in the ratio with which the picks, as compared with the threads per inch, are reduced, but the surface quality of the fabric is modified. A cloth, for example, made of 2/100's cotton in the warp and weft, with 92 threads and picks per inch finished, would, on comparison, be found to differ from

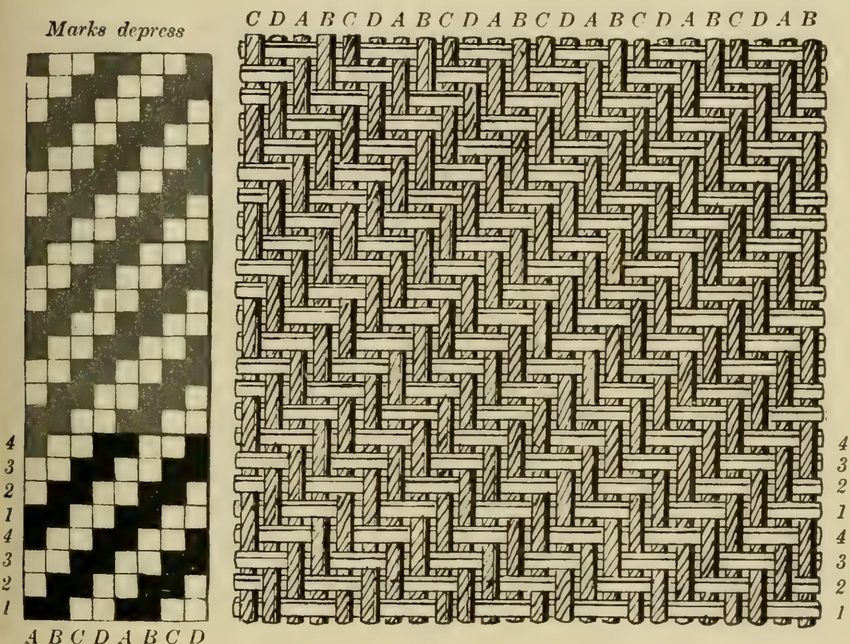


FIG. 62.—CASSIMERE OR $\frac{2}{2}$ TWILL FABRIC STRUCTURE.

a cloth in which the warp was 2/100's with 92 threads per inch, and the weft 2/60's with 72 picks per inch. Both cloths would be approximately of the same weight per yard, that is, of the same filament density, but the thicker counts of weft in the second cloth, though the picks should be proportionate in number with the difference in the diameters of 2/100's and 2/60's, or in the ratio of 184·55 to 142·95, would change the cloth structure and quality. Still, this method of fabric construction, with a view of reducing the cost in weaving, and also in

manufacture, by employing in the weft a lower count of yarn than that used in the warp, is followed. The practice has another effect—it changes the character of the weave, especially if this is of a twilled type. In fabrics woven on the square, the angle of the common twills is 45°. By lowering the picks,

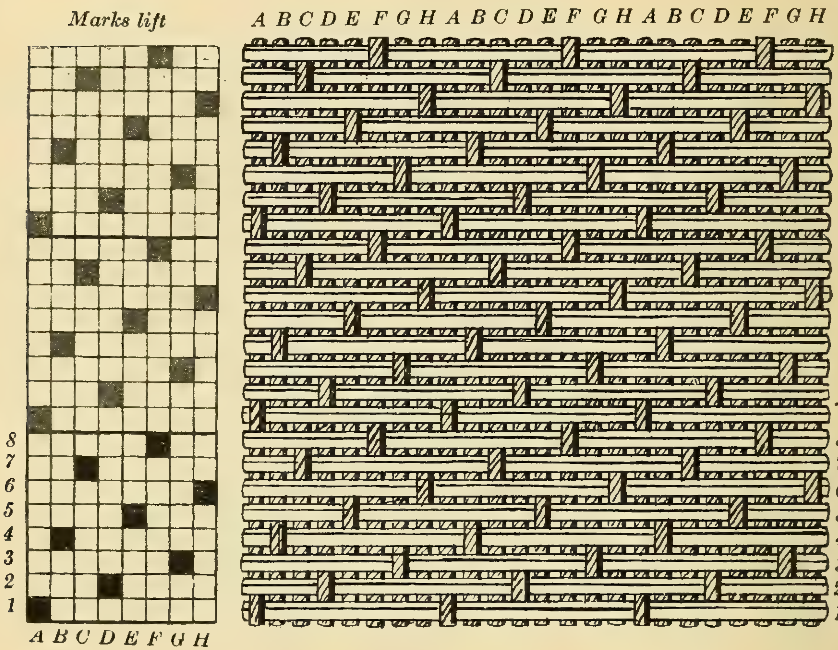


Fig. 63.—Sateen Fabric Structure.

in comparison with the threads per inch, the lines of the twill are elongated. Should, for instance, specimen 15, Table VIII, be woven in 2/120's worsted with 110 threads per inch, and wefted with 40's worsted, 80 picks per inch, the $\frac{2}{2}$ twill angle would be changed from 45° to one of about 70°. In a plain weave, this alteration of the picks, relative to the ends, also modifies the fabric character. For example, a spun-silk texture, No. 6, with 130 warp ends per inch, woven with 50's cotton and 92 picks per inch, would give a repp or cord texture.

The production of cloths on this basis, that is, unbalanced in the warp and weft setting, is practised in different branches of dress manufacture, especially in cloths of a repp, poplin, and a like character.

135. *Coloured Effects and Yarn Diameters.*—The manner and degree in which the counts of yarn modify the pattern development, resulting from the grouping of coloured yarns in the warp and weft, will be explained by comparing the textural styles in Figs. 64, 65, 66, 67, and 68. They are respectively woven in silk, cotton, linen, woollen and worsted yarns, and the several effects are produced in the plain weave. The orders of the colourings are as follows—

SILKS. Fig. 64—A, B, C, D, E, F, G

Specimen A—	*Warp :*	White	6	6	1	1	1	1	1	′
		Black	4	2	1	1	1	1	1	2
	Weft :	All Black.								
,, B—	*Warp :*	White	6							
		Black	4							
	Weft :	White	4							
		Black	6							
,, C—	*Warp :*	White	9	3						
		Black	3	3						
	Weft :	White	10	2						
		Black	2	2						
,, D—	*Warp and Weft :*	White	6							
		Black	16							
,, E—	*Warp and Weft :*	White	8							
		Black	20							
,, F—	*Warp and Weft :*	White	8	8						
		Black	2	10						
,, G—	*Warp and Weft :*	White	4							
		Black	4							

COTTON. Fig. 65—A and B

Specimen A—	*Warp and Weft :*	White	8						
		Black	8						
			40						
,, B—	*Warp and Weft :*	White	2	2	2	2	2	2	2
		Black	2	2	12	2	12	2	12

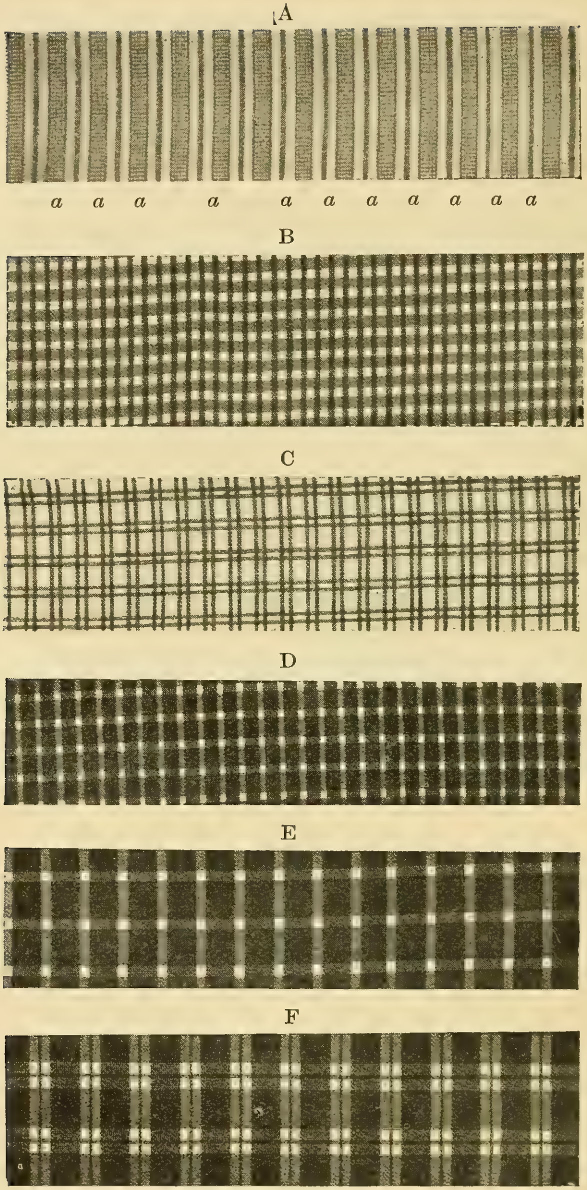


FIG. 64.—COLOURED SILK STYLES—PLAIN WOVEN.

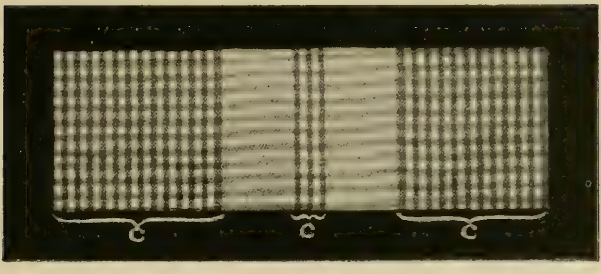


FIG. 64G.—SILK COLOURED STYLE.

LINEN. Fig. 66—A, B, C

Specimen A—	*Warp and Weft :*	White	3
		Black	3
,, B—	*Warp and Weft :*	White	4
		Black	2
,, C—	*Warp and Weft :*	White	5
		Black	5

WOOLLEN. Fig. 67—A, B, C, D

Specimen A—	*Warp and Weft :*	White	2
		Black	2
,, B—	*Warp and Weft :*	White	4
		Black	4
,, C—	*Warp and Weft :*	White	6
		Black	6
,, D—	*Warp and Weft :*	White	8
		Black	8

WORSTED. Fig. 68—A and B

Specimen A—	*Warp :*	White	15	15	1	1			
		Black	3	1	1	3			
	Weft :	All White.							
,, B—	*Warp and Weft :*	Black	1	1	1	1	2	2	4
		Grey	1	1	1	1	2	2	4
		White	1	1	1	1	2	2	4

The yarn counts, ends, and picks per inch, and approximate weights per yard (30 in. × 36 in.) of the different specimens, being typical of the influence of the diameter of the loom setting,

as well as of the fineness of the texture manufactured, are tabulated below—

Specimens.	Yarn Counts.	Yarn Dia.	Ends per inch.	Picks per inch.	Weight in ozs. per yd. 30″ × 36″.
Fig. 64 A, B, C, D, E, F.	52 denier silk	$\frac{1}{261}$	132	130	1·54
Fig. 64G.	72's/2 silk	$\frac{1}{218}$	108	106	1·84
Fig. 65A	2/80's cotton	$\frac{1}{165}$	82	80	2·40
Fig. 65B	2/60's cotton	$\frac{1}{142}$	70	70	2·81
Fig. 66 A and C	2/32's linen	$\frac{1}{64}$	32	32	6·4
Fig. 66B	2/20's linen	$\frac{1}{50}$	26	24	8·27
Fig. 67 A, B, C, D, E,	10 skeins woollen	$\frac{1}{42}$	21	21	8·7
Fig. 68 A and B	2/22's worsted	$\frac{1}{71}$	36	36	5·62

A primary feature for comparison in these plain-woven coloured styles, is the differentiation in their surface tone and character, which is particularly observed in the fineness of the

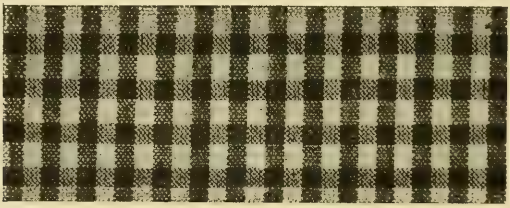


FIG. 65A.—SILK COLOURED STYLE.

silk, the clearness of the cottons, the thread-like definiteness of the linens, the softened pattern characteristic in the woollens, and the surface smartness of the worsteds. These distinguishing elements and qualities in the fabrics are primarily of a filament origin. The same series of effects, if woven in metallic threads of the different sizes, and in the different settings tabulated, would satisfactorily develop the several schemes of design

detail, varying in scale from a minimum type in the smallest diameter of thread, to a maximum type in the threads of the greater circumferential area. But in threads of silk, cotton, linen and woollen, other textural properties are seen, and the species of patternwork produced are modified by (*a*) the variety of fibre of which the yarn is spun, and (*b*) by the system of yarn structure adopted in preparing and spinning.

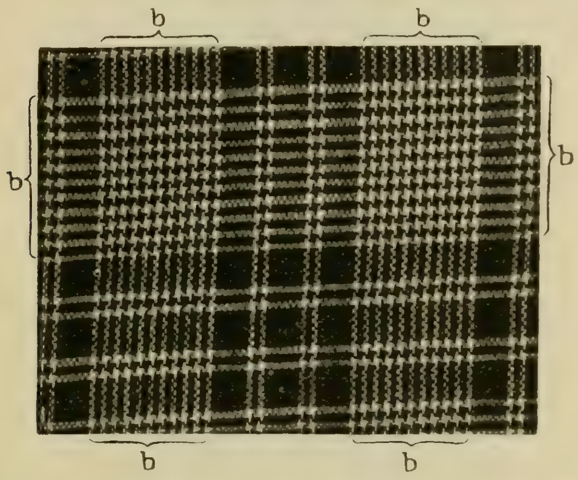


Fig. 65b.—Cotton Coloured Style—Plain Woven.

136. *Pattern Contrasts.*—In each group of cloths represented, it is evident that clear and precise pattern delineation is feasible. Though the effects are minute in the silk specimens, they are clearly distinguishable ; and, in corresponding warping and wefting, conform in type with those obtained in the woollen yarns of five or six times the diameter. All descriptions of textural pattern derived from certain orders of weaving two or more shades of warp and weft yarns, agree in detail and in style in whatever class and counts of yarn produced. The fineness, openness, or structural compactness of the pattern, is, however, dependent on the size of the yarns, and on the sort of filament of which the yarns are made. This will be rendered more apparent by examining and comparing the coloured

specimens in Figs. 64, 65, 66, 67, and 68. These comprise the following series of pattern types and contrasts—

I. Contrasts in "1-and-1" colouring as exemplified in silk and worsted textures, parts *a* in Figs. 64A and 68A. The "1-and-1" forms the most elementary order of warp and weft

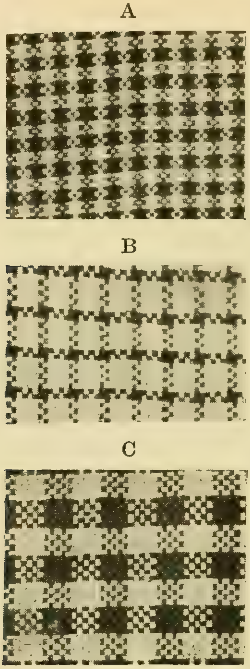


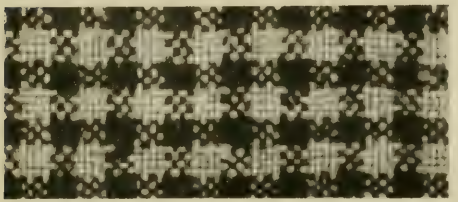
FIG. 66.—LINEN COLOURED STYLES—PLAIN WOVEN.

colouring, and gives the finest species of colour effect obtainable in woven fabrics. When the order of shuttling is in accord with the order of warping, lines in the two shades of yarn are formed in the length or in the width of the cloth. If the warping, as in these examples, should be arranged 1-and-1 and the wefting be in one colour, the lines become broken or specked. In Fig. 64A they are extremely fine in character, but in Fig. 68A—in which the yarns are of a thicker diameter,

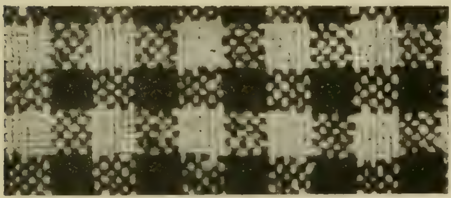
two threads as one—the lines are better defined, and produce what is known as the bird's-eye spot. The points to be

A

B



C



D

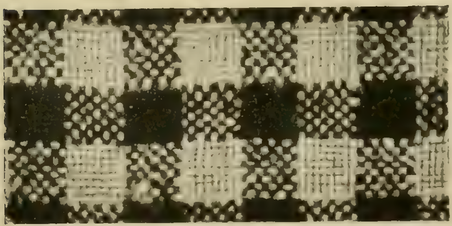


FIG. 67.—PLAIN WOVEN WOOLLEN COSTUME STYLES.

specially noted are the increased closeness and minuteness of the detail in the silk as compared with the worsted, and the perfect symmetry of the pattern type in both cloths.

II. Contrast in " 2-and-2 " colouring, as seen in the cotton and woollen specimens in section *b*, Fig. 65B, and in Fig. 67A. This grouping of warp and weft threads constitutes the simplest check basis, and is applicable to the different varieties of weave and fabric structures. In cotton and woollen yarns it is suggestive (1) of the perfect agreement of the pattern types producible in small and thick threads, the diameter of the

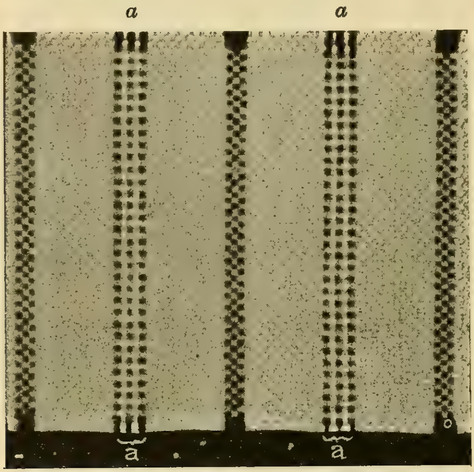


FIG. 68A.—WORSTED COSTUME STYLE.

cotton threads in Fig. 65B being $\frac{1}{142}$ and of the woollen threads in Fig. 67A, $\frac{1}{42}$; and (2) of the clearness of the effects when woven in cotton textures, and of the rougher character the effects possess when woven in woollen textures.

III. Contrasts in the " 4-and-4 " colouring in silk and woollen yarns, as observed in section *c*, Fig. 64G, and in Fig. 67B. This order of checking, as that in the " 2-and-2," is a standard colouring in each class of fabric—linen, silk, cotton, woollen, and worsted. It is a severer rectangular pattern than that obtainable by warping and wefting 2-and-2. The difference in the textural style in these examples is very pronounced, owing, in the first place, to one repeat in the woollen being

equal to several repeats of the checkings in the silk; and, in the second place, to the fine, smooth surface of the silk (Fig. 64G) as compared with the somewhat irregular and broken surface of the woollen (Fig. 67B).

IV. Contrasts in the "8-and-8" colouring as illustrated in the silk specimen in Fig. 65A, and in the "3-and-3" colouring

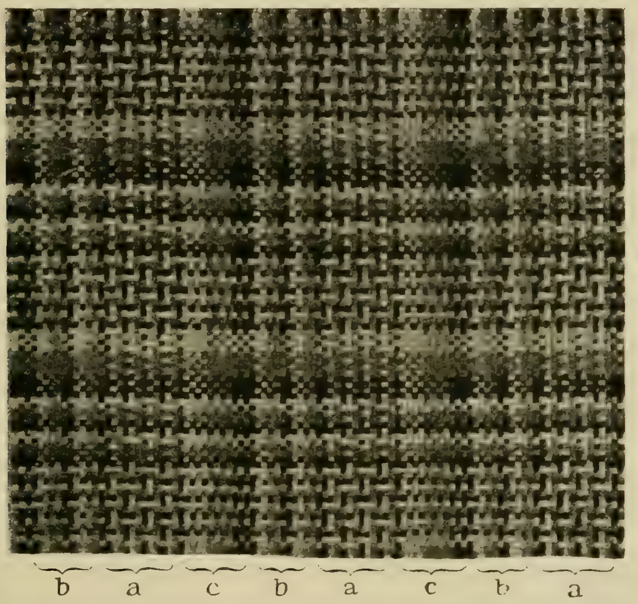


FIG. 68B.—WORSTED COSTUME STYLE—COMPOUND COLOURING.

in the linen specimen in Fig. 66A. Here the two patterns differ in dimensions, but, in the finer yarn, a repeat of the pattern contains twelve threads, and, in the heavier counts of yarn, only six threads. The interlacings of the yarns are consequently more marked in the linen than in the silk texture. It should be observed that the grouping of the threads and picks in odd multiples (Fig. 66A) such as 3-and-3, 5-and-5, 7-and-7, etc., produces a more diversified form of checking than the grouping of threads and picks in even multiples, such as 4-and-4, 6-and-6, etc.

V. Contrasts in strong or pronounced checkings and as typified in the silk textures in Figs. 64E and F, in the cotton sample in Fig. 65B, in the linen fabric Fig. 66C, and in the woollen cloths in Fig. 67, C and D. In these specimens the qualities of the pattern due to the yarn unit are better observed than in the smaller variety of checkings. The warp and weft lines, forming the checks, are the most distinctly developed in the silk fabrics (Fig. 64, E and F) which indicates that the smoothness of this yarn, combined with its fineness, makes it adapted for the delineation of pattern style as acquired from the grouping, and in a specified order, of warp and weft threads. The cotton check (Fig. 65B) is looser in structure, and the lines, whether in warp or weft, are less smartly defined. If the yarns had been mercerised the checking would have more closely corresponded with the patterns obtained in silk; but, in the case of ordinary cotton threads, the rawness of the pattern tone is quite appreciable as contrasted with the neatness and brightness of the pattern tone in specimens E and F, Fig. 64.

The straightness and evenness of the linen yarns (Figs. 66A, B and C) assist in developing the clear checkings characteristic of this class of fabric. The detail features in the patterns, produced by crossing the warp and weft yarns, are also better distinguished in linen than in cotton manufactures.

The size of the pattern forms in these several examples, emphasizes the coarser and rougher grain of the woollen-yarn cloths, C and D, Fig. 67. The thickness of the threads and their undulated and fibrous surface, and also the open setting practised in weaving such specimens, develop broadness of character in the checkings. In the intermediate sections between the solid squares of black and white, in which the two yarns are equally intermingled, the plain build of the cloth is clearly brought out.

VI. Contrasts in patterns having a light-tinted ground as in the examples reproduced at C and D (Fig. 64), at Fig. 66B, and at Fig. 68A. It will be seen that the checking lines in the

silk and linen (Figs. 64C and 66B) are precisely accentuated with the repeats of the patterns formed in a small number of ends and shots ; while the stripings in the worsted (Fig. 68A) being crossed with white weft, are less continuous in character but well pronounced in tone. In light-coloured yarns the make of the fabric is more visible than in dark-coloured yarns, and this adds to the interest and structure of the woven style. Without magnification, the interlacings of the warp and weft, especially in medium and coarser-set cloths, are traceable, as is apparent in the linen style in Fig. 66B and in the worsted style in Fig. 68A.

VII. The contrasts in worsted yarns, as observed in sections *a*, *b*, and *c* of Fig. 68B, are suggestive of the degree of pattern emphasis possible in the use of three shades of yarn, and also of the special adaptability of Botany worsted yarns for the development of colour effects. This intermingled check style is obtained by combing three orders of colouring, namely the 3-odd thread, the 3–2's and 3–4's methods of warping and wefting. Each section of the pattern thus composed, contains twelve threads and twelve picks. The medium shade, in neutral grey, is a yarn consisting of 50 per cent. of black and of 50 per cent. of white fibre, mingled together in the drawing operations. Both woollen and worsted yarns are suitable for use in coloured pattern work, in the form of "mixture" or "*mélange*" yarns. In such shades, they provide scope for pattern schemes, resulting in toned or graduated styles, as in dark, intermediate, light, and very light colourings. If the tinted ingredients, admixed in the processes of yarn-making, are in strong contrast with each other, each hue or colour in the yarns may give tone to the composite colour of the fabric ; but in other yarns, where the colours blended are analogous in hue, the yarns have, in the fabric, a solid colour quality.

The range of tinting in dress and costume cloths, is widened and varied by this practice in woollen and worsted yarn manufacture. The worsted threads also provide for the smart development of "weave" design, in addition to the clear

expression of the pattern types acquired by the system of grouping the warp and weft yarn units on the principles defined.

137. *Comparison of Standard Cotton Yarns.*—For the purpose of indicating the relative sizes and qualities of the cotton yarns standardized and employed in the dress fabric industry, the following varieties of yarns are reproduced to scale, in Figs. 69, 69A, B, C, D, E, and F—

Group I. Fig. 69, Hard Twisted Mule-Spun Yarns—
Specimen A = 2/16's, B = 2/20's, C = 2/30's, and D = 2/40's counts.

Group II. Fig. 69A, Frame Spun-Yarns—
Specimen E = 2/16's, F = 2/20's, G = 2/30's, and H = 2/40's counts.

Group III. Fig. 69B, Carded Yarns, Ordinary Twine—
Specimen I = 2/20's, J = 2/40's, K=2/60's, and L=2/100's counts.

Group IV. Fig. 69C, Combed Yarns, Ordinary Twine—
Specimen M = 2/20's, N = 2/80's, and O = 2/100's counts.

Group V. Fig. 69D, Carded and Gassed Yarns, Soft Twine—
Specimen P = 2/20's, Q = 2/40's, R = 2/60's, and S = 2/80's counts.

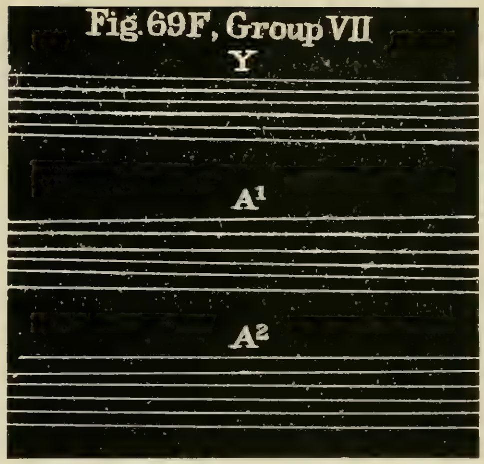
Group VI. Fig. 69E, Combed and Gassed Yarns, Soft Twine—
Specimen T = 2/20's, U = 2/40's, V = 2/60's, W=2/80's, and X = 2/100 counts.

Group VII. Fig. 69F, Voile Yarns, Gassed—
Specimen Y = 1/50's, A^1= 2/80's and A^2 = 2/100's reversed twine.

Examining these threads under magnification reveals the following features—

(1) The comparative firmness of the hard-twisted mule-spun yarns (A, B, C, and D) making them adapted to the manufacture of the stronger builds of fabric, and the comparative evenness of the frame-spun yarns (E, F, G, and H) rendering them valuable in the production of cloths of a true and fine character. Both these yarns are useful in the development of textural or weave effects.

(2) That in the ordinary degree of twist, the two yarn types (carded and combed) differ in levelness and smoothness, which is evident on magnifying and comparing samples I, J, K, and L, with M, N, and O. These differentiations are equally



COTTON YARN SPECIMENS

Fig. 69.—Self-Actor Spun Yarns.

Fig. 69a.—Frame Spun Yarns.

Fig. 69b.—Carded Yarns—Ordinary Twine.

Fig. 69c.—Combed Yarns—Ordinary Twine.

Fig. 69d.—Carded Yarns—Gassed.

Fig. 69e.—Combed Yarns—Gassed.

Fig. 69f.—Voile Yarns—Gassed.

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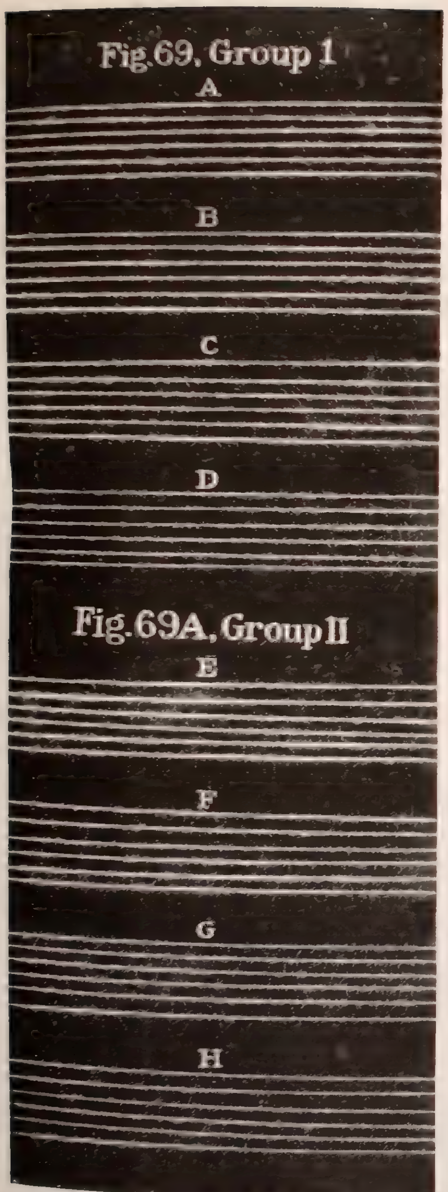

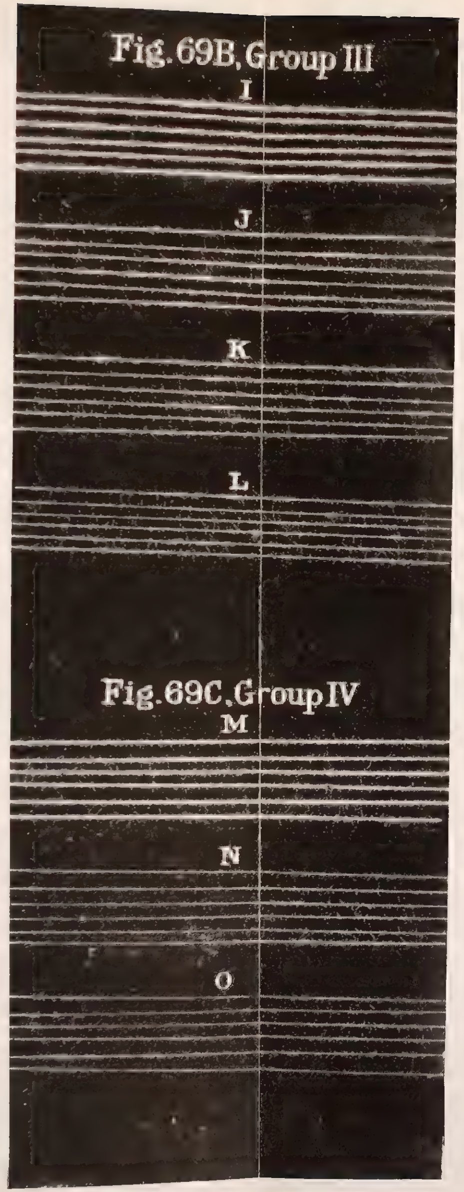

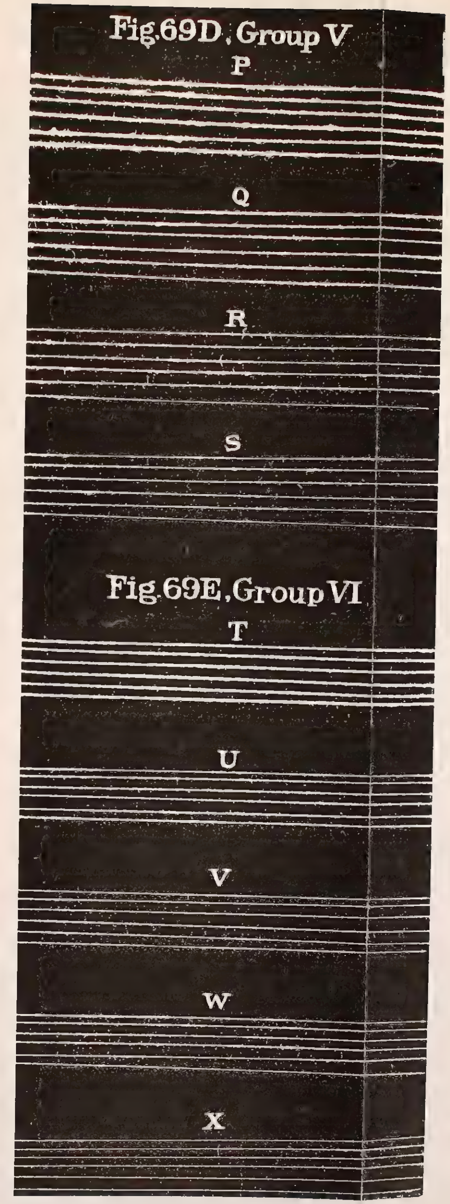

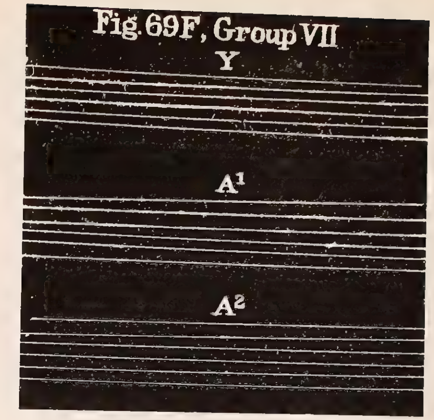

COTTON YARN SPECIMENS

Fig. 69.—Self-Actor Spun Yarns.

Fig. 69a.—Frame Spun Yarns.

Fig. 69b.—Carded Yarns—Ordinary Twine.

Fig. 69c.—Combed Yarns—Ordinary Twine.

Fig. 69d.—Carded Yarns—Gassed.

Fig. 69e.—Combed Yarns—Gassed.

Fig. 69f.—Voile Yarns—Gassed.

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observed in the lower as in the higher counts of yarn. The carded and mule-spun yarn is obviously suitable for producing cloths with a filament surface, as acquired by ordinary practice, and also by raising; while the clear, even formation of the combed yarn, in 2/20's, 2/80's, and 2/100's counts, is, as now understood, the sort of yarn for defining pattern detail due to the methods of crossing threads of warp with shots of weft.

(3) The effect of gassing, in cleaning the surface of the yarns of extraneous fibre, is apparent in both the carded threads Q, R, and S, and in the combed threads T, U, V, W, and X. The quality of fabric obtainable from such yarns, as compared with like counts of yarns ungassed, is one of distinctness of structure, supplemented by smartness of textural face.

(4) The mechanical equality of thread, of a hard-twisted nature, applicable to the making of voile fabrics, is illustrated in Fig. 69F, or in the single fine-spun yarn Y, in the 2-fold twist A^1, and in the 2-fold thread, reversed twine, A^2. For voile cloth manufacture, these structural features in the yarn are essential in acquiring (*a*) clearness and fineness of texture, and (*b*) strength, fineness and firmness of fabric build.

CHAPTER V

WEAVE ELEMENTS AND CLOTH CONSTRUCTION

138. *Fabric Build.*—The build or construction of the woven fabric is dependent on the order of interlacing the warp and weft threads in the operation of weaving. Four fundamental systems of intertexture are sketched in Figs. 60, 61, 62, and 63 pages 161 to 164.

The looming plans, as prepared on ruled or square paper, are shown at the side of the drawings. These respectively comprise 2, 3, 4, and 8 threads of warp and picks or shots of weft. In Fig. 60 the point paper is marked in alternate squares; in Fig. 61 in twilled arrangement, marking one square and omitting two squares on each pick; in Fig. 62 squares A and B are marked on pick 1, B and C on pick 2, C and D on pick 3, and D and A on pick 4; and, in Fig. 63, square A is marked on pick 1, and D on pick 2, following this scheme of distribution of the marks to the 8th pick in the plan. The textures produced by the different crossings are seen to be dissimilar in

formation. In each example the plan of marking the point paper exactly coincides with the system of interlacing, or with the fabric "make" or "build," giving in Fig. 60 a *plain*, in Fig. 61 a *prunelle*, in Fig. 62 a $\frac{2}{2}$ twill or *cassimere*, and in Fig. 63 a *sateen* cloth. In the plain and the $\frac{2}{2}$ twill textures, the warp and weft yarns are equally floated on the face and on the underside of the cloth; whereas, in the prunelle, there are two parts of warp to one part of weft on the face, and on the back two parts of weft to one part of warp; and in the sateen $\frac{7}{8}$ of warp on the upper surface to $\frac{1}{8}$ of weft, and on the lower surface $\frac{7}{8}$ of weft to $\frac{1}{8}$ of warp; or, as in Figs. 61 and 63, the positions of the yarn units may be reversed.

The alternate principle of intersection in Fig. 60 represents the first principles of cloth construction. The prunelle is typical of all ordinary twilled weaves, in which one thread of warp in the series of threads combined, i.e. 4, 5, 6, 7, etc., is crossed or covered by one pick of weft—an order of intersection which enables either a warp or a weft face twilled cloth to be woven. The cassimere is the most elementary type of twilled weave producible in which the warp and weft lines are equal in dimensions on both sides of the texture. The sateen is a different type of weave, being illustrative of the varieties of texture, having either a warp or weft surface, in which the interlacings are at least one thread and one pick apart, the distance of one intersection from the other being mathematically fixed by the ends and picks occupied by the weave.

139. *Weave Diversification and Loom Mechanism.*—Weave diversification is restricted by the capacity of the loom, or by the practice in "warp shedding," and also by the practice of shuttling or of inserting the picks of weft. In shedding, the warp threads are displaced in consecutive groups (each group corresponding to a fraction of a repeat of the weave) for the passage of the shuttle, by "shafts," "staves," or "heddles," as in the treadle, tappet, and dobbie looms, or by "harness cords," as in the Jacquard machine. In the use of shafts,

the possible individual movements of the warp ends are limited to the number of shafts or shedding units employed, which rarely exceeds 8 in the tappet motion and 32 or 36 in the dobbie. In the harness mounting, the range for textural design is much greater, being equivalent to the number of control wires in the machine—100, 200, 300, 400, 600, or as many as 1,200 to 2,000. Cloth planning is, however, mainly restricted to weave elements obtainable on 2, 3, 4, and other numbers of shafts. The weave elements formable in each series of shafts are extensible in the picks, for the repeat of a weave may be confined to a small number of threads but comprise a larger number of shots, as, for example, in the origination of fancy twills and diagonal patterns.

140. *Weave Classification.*—Dress-fabric construction, owing to the diversity of fibrous materials in which the goods are manufactured, and also the diversity in the thickness of the yarns utilized, and to the range of " settings " in the warping and wefting, offers the fullest latitude for variation in cloth build, arising from, and determined by, the methods of yarn interlacing. In this connection " weave " might be studied in respect to the units of effect obtainable in specific shaft mountings, i.e. mountings consisting of different numbers of heddles. Taking the plans made on 2, 3, 4, 5, etc., shafts as representative of different varieties of intertexture, this system of classification would include, in these several shaft mountings, weaves of a like category in addition to the special types of weave workable in each series of shedding units comprised.

The subject will, therefore, be dealt with as it is divisible into weave principles of special application to dress goods, blouse textures, and worsted and union costume cloths. At the same time attention will be given to the numbers of shafts employed in forming weave types. Weaves of one healding denominator will be considered as such, and it will be shown in what way they differ in textural utility from weaves of a similar construction having other working denominators.

Thus examined, " weave " structures and " weave " patterns are reducible to following distinctive classes—

TABLE IX

GROUP CLASSES OF ELEMENTARY WEAVES

I. The Plain Weave and its Derivatives.
II. Warp-Face and Weft-Face Twills.
III. Balanced Twills, e.g. Twills of an equal number of Warp and Weft intersections on both sides of the cloth and with the lines of Warp and Weft equal in size.
IV. Derivatives of the Common or Standard Twills included in Classes I and II.
V. Elongated Twills—(*a*) in the Warp, and (*b*) in the Weft.
VI. Crêpe Twills and Crêpe Weaves.
VII. Cords, Cord Twills and Stripes.
VIII. Compound Twills and Small Diagonals.
IX. Checkings or Dice Patterns.
X. Waved and Serpentine Patterns.
XI. Diaper, Diamond and Lozenge Effects.
XII. Transposed Effects.
XIII. Mock-leno Plans.
XIV. Honeycombs.
XV. Sateens.
XVI. Twilled Mats.
XVII. Irregular Weaves.

141. *Uses of the Plain Weave.*—The plain make is used in all the different branches of the dress-fabric industry. It is applied to cloths of one colour, and to cloths of one colour of warp and of a second colour of weft, and results in the production of silk, cotton, linen, worsted, and woollen manufactures. The loom setting is, in each method of application, adapted to the style of fabric required. Thus plain textures are made in such yarn qualities and counts, and in such settings as typified below—

A.—SILKS

I. *Crêpe de Chine*—

Warp : 52 denier organzine.
Weft : 52 denier trame.
120 threads and shots per inch.

II. *Spun Silk variety*—

Warp : 60's 2-fold silk.
Weft : 60's silk.
96 threads and 90 shots per inch.

B.—Cotton Textures

I. *Muslins*—

(*a*) Common or "Book" Variety.	(*b*) Medium Variety.	(*c*) Fine Variety.
Warp : 60's cotton.	Warp : 80's cotton.	Warp : 120's cotton.
Weft : 60's cotton.	Weft : 100's cotton.	Weft : 190's cotton.
40 threads and 30 shots per inch.	80 threads and 62 shots per inch.	112 threads and 120 shots per inch.

II. *Crimps*—

Warp : 2/60's cotton.
Weft : 25's cotton.
70 threads and 60 shots per inch.

III. *Voiles*—

Warp : 2/80's cotton.
Weft : Reversed twine.
80 threads and 65 shots per inch.

IV. *Flannelettes*—

Warp : 30's cotton twist.
Weft : 15's cotton.
60 threads and 70 shots per inch.

C.—Linens

I. *Thin Structures*—

Warp : 2/336's linen.
Weft : 1/164's linen.
96 threads and 90 shots per inch.

II. *Canvas Structures*—

Warp : 2/56's linen.
Weft : 28's linen.
40 threads and shots per inch.

D.—Worsted

I. *Botany*—

Warp : 2/60's worsted.
Weft : 30's worsted.
54 threads and 52 shots per inch.

II. *Cross-breds*—

Warp : 2/16's worsted.
Weft : 2/16's or 8's worsted.
24 threads and 22 shots per inch.

E.—Woollens

I. *Saxony-Hailines*—

Warp and Weft :
1 thread of 32 skeins dark shade.
1 ,, ,, ,, light ,,
40 threads and shots per inch.

II. *Cheviot*—

Warp and Weft:

16 Threads. { 2 threads of 12 skeins medium shade.
2 ,, 12 ,, light ,,

8 Threads. { 1 thread of 12 skeins medium shade.
1 ,, 12 ,, light ,,

20 threads and 18 shots per inch.

F.—UNIONS

I. *Delaines*—

Warp: 30's cotton.
Weft: 30's Botany worsted.
60 ends and picks per inch.

II. *Lustres*—

Warp: 2/120's or 1/60's cotton.
Weft: 32's Lustre worsted or mohair.
60 ends and 56 picks per inch.

III. *Costume Cloths* (*Face Finished*)—

Warp: 2/40's cotton.
Weft: 28 skeins woollen.
48 ends and picks per inch.

142. *Loom Setting and Cloth Variation.*—The above settings illustrate the manner in which cloth variation is acquired in any description of yarn for giving a definite class of woven manufacture. In the cotton crimp, the warp is woven slackly tensioned, which has the effect of developing the creased effect in the fabric. The yarn for the flannelette cloth requires to be of a condition suitable for raising, that is, soft in twine, while that for voile should be of the hard-twisted type defined previously. For developing the plain weave intersections clearly in the linen, examples C, the weft may be 2-fold as well as the warp, but the use of the single weft imparts a degree of softness of handle to the cloths.

Colour effects and styles are largely woven in the plain make as illustrated in Figs. 64, 66, and 67. In settings E, the colour practices in producing hairlines in Saxony yarns, and small checkings in Cheviot yarns, are exemplified. Of the

orders of warp and weft colouring applicable to this weave in all kinds of yarn the following are standards—

1-and-1, 2-and-2, 3-and-1, 2-and-2, 3-and-3,
4-and-4, 4-and-1, 2-and-1, 6-and-6, 8-and-8, etc.,

wefting in one shade of yarn, or in the same order as warped.

143. *Systems of Weave Extension.*—The plain make, and many of the elementary weaves—those occupying 3, 4, 5, 6, 7, and 8 shafts—are subject to three forms of extension, first in the warp, second in the weft, and third in both warp and weft. On the first principle, the picks are duplicated variously as in A^1, A^2, A^3, A^4, and A^5, Fig. 70, giving, on the basis of the plain weave, different species of warp cords, such as 2-and-2, 3-and-3, and 4-and-4, and the nondescript types at A^4 and A^5. By an extension of the threads as in A^6 and A^7, or by inverting weaves A^1 to A^5, weft repps or cords are formed. The construction of mats or hopsacks as in A^8, A^9, and A^{10}, is the result of duplicating both the ends and shots of the weave A. If, in this double extension, the process of duplication is irregular elongated mats are produced as at A^{11} and A^{12}. Combining these three systems of extension, mat, and warp and weft cord effects, of the character illustrated in A^{13}, A^{14}, and A^{15}, are acquired. Makes of the mat and compound mat and cord class are usually woven on the square, but for correct cloth production, in *warp* cords, there should be a larger number of threads than picks per inch, and, in the *weft* cords, a fuller number of picks than threads. This is the general rule observed in the manufacture of all descriptions of repp and cord textures.

144. *Prunelle and Warp or Weft Face Twills.*—The prunelle (Fig. 71) is the twilled weave obtainable on the lowest series of heddles. It is the weave used in the making of Cashmere shawls, possibly on account of the advantage it offers in the process of weaving over the $\frac{2}{2}$ twill, only one-third of the threads in the warp being lifted for each pick of weft inserted into the piece. The "cassimere," a corruption of "kerseymere," makes a firmer build of cloth, but the prunelle is also

largely used in producing fine fabrics in either worsted or woollen costume cloths. Stripes and check patterns are obtained by combining plans A and B (Fig. 71) sectionally. The prunelle only yields a small group of derivatives. An

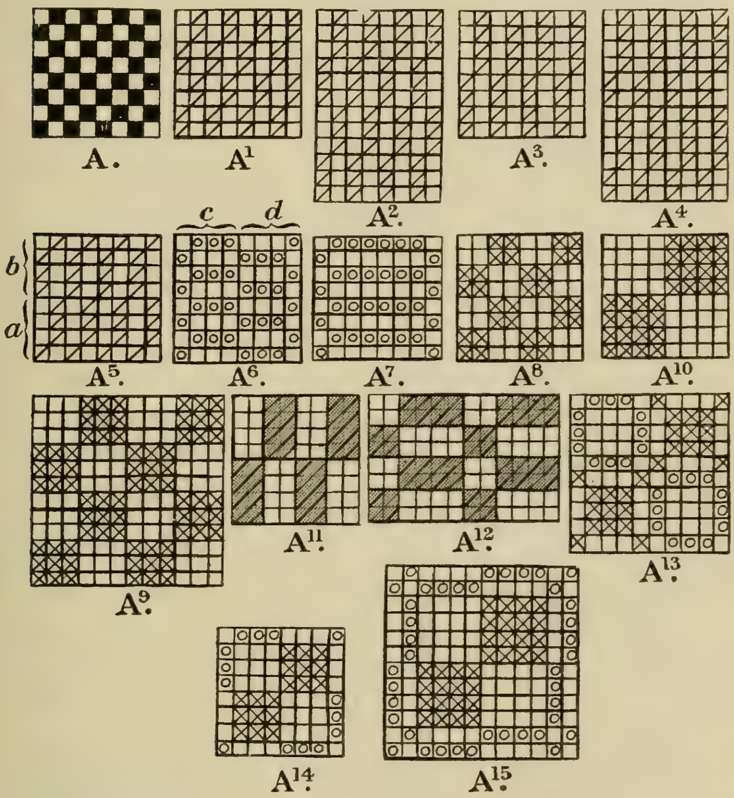


FIG. 70.—EXAMPLES IN WEAVES DERIVED FROM THE PLAIN MAKE.

extension of the picks gives the upright warp twill, A^1, of the threads the oblique twill, A^2; and of the picks and threads, the mat twill, A^3. The two weaves A and B are also arranged pick-and-pick and thread-and-thread, yielding, first, the cut twill effect, A^4, in which the warp twill moves to the right, and the weft twill to the left; second, the weft-backed prunelle, A^5, and third, A^6, the warp-backed prunelle A^6.

145. *Cassimere and Twills of a Similar Formation.*—These include the common varieties of twilled weaves, and are only producible on an even number of threads and picks as shown in weaves A and B (Figs. 72, 75, and 77). As both warp and weft interlacings in such weaves have a like function and prominence in the fabric, they make the truest type of cloth structure, agreeing in this particular with the plain or calico weave. By unbalanced loom-setting, emphasis may, however, be given to either the warp or the weft elements, and the normal angle of the twill modified. For example, in a cloth with 64 ends and picks per inch, the twilled lines, in the $\frac{2}{2}$ weave (A, Fig. 72), in the $\frac{3}{3}$, (A, Fig. 75), and in the $\frac{4}{4}$ weave (A, Fig. 77), would have an angle of 45°, or they would present the same angle as that of the twilled lines in the point-paper plans. Should these plans be prepared on 8×16 and on 16×8 paper, they would show, in a theoretical form, the approximate lines of the twills due to changing the loom setting to 64 *picks* and 32 *threads*, and to 64 *threads* and 32 *picks* per inch. It follows that a departure from the plan of uniformity of threads and picks per inch, in the weaving of a twilled fabric, the angle of the twilled lines in the piece becomes altered. It is a method practised, to a limited extent, in changing a common into a more or less upright or a more or less oblique twill; and also in reducing the cost of fabric construction by lowering the number of picks as compared with the threads per inch.

146. *Two-and-Two Twill Derivatives.*—The larger the number of ends and picks occupied by weave, the greater as a rule the range of weaves derivable from a given plan of interlacing. This is seen on comparing the type of effects obtainable by the re-arrangement of the threads or picks of the weaves A and B (Fig. 71) and the weaves A and B (Fig. 72). Whereas from the prunelle twill only three distinctive weave types are obtained, from the $\frac{2}{2}$ twill such different weave elements result as those illustrated at A^1 to A^6 and at B^1, C^1, and C^2 (Fig. 72). Here plans A^1, A^2, and A^3 are respective

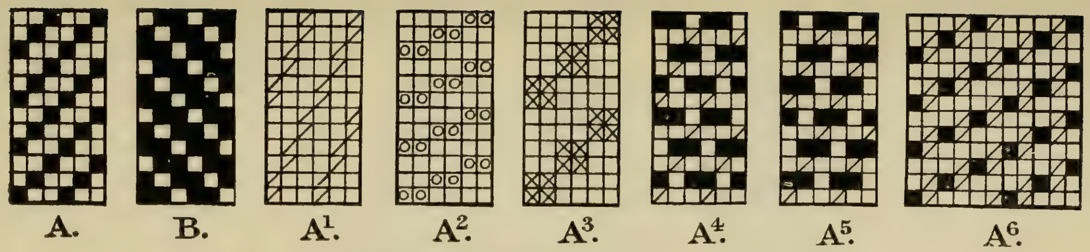


FIG. 71.—EXAMPLES IN PRUNELLE-TWILL DERIVATIVES.

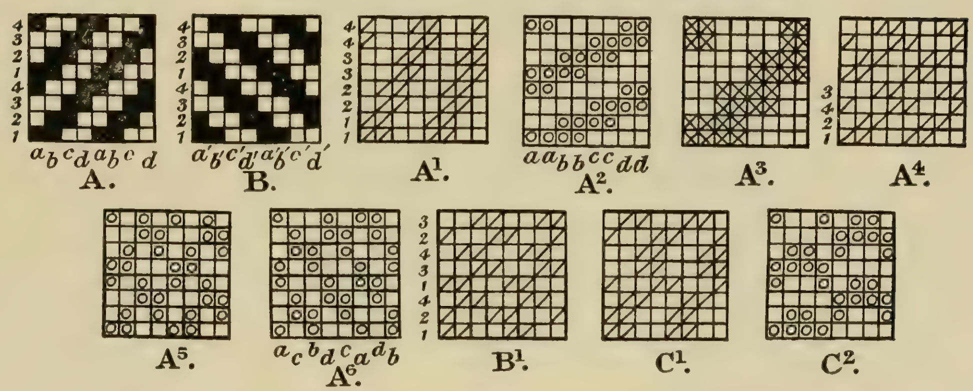


FIG. 72.—EXAMPLES IN CASSIMERE-TWILL DERIVATIVES.

extensions of the picks, the threads, and of both the threads and picks of the weave. Further, the re-grouping of the picks in the order of 1, 2, 4, and 3 forms the crossing at A^4 or a weave-cutting in two's in the picks, and the re-grouping of the threads in the order of *a*, *c*, *b*, and *d* gives the crossing at A^5, or a weave-cutting in two's in the threads. Combining the two plans A and B, Fig. 72, pick-and-pick, makes the small broken mat effect at C^1, cutting on the 3rd and 4th, and on

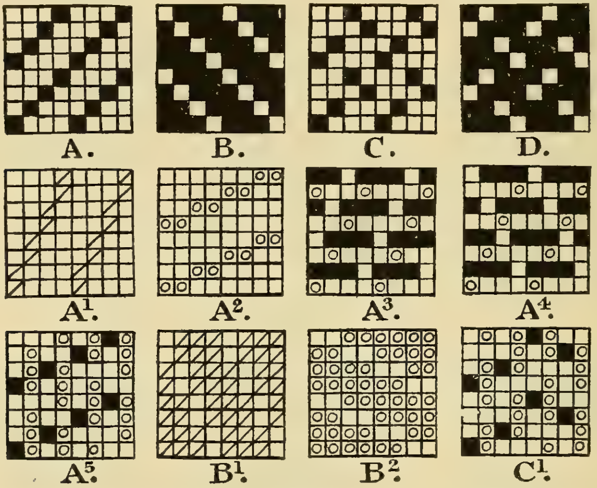


FIG. 73.—EXAMPLES IN SERGE-TWILL DERIVATIVES.

the 7th and 8th picks ; and combining the same two weaves thread-and-thread, produces the broken mat weave at C^2, cutting on the 4th and 5th and on the 7th and 8th threads. Other methods of thread and pick re-arrangement are shown at A^6 and B^1.

147. *Four-end Serge Twills.*—Extensions of these weaves (A and B, Fig, 73) are given at A^1, B^1, A^2, and B^2, and modifications of the weaves, by transposing the order of the threads, are given at C and D. The two latter are known as the broken "swansdown," and have a specialized application in the weaving of cloths with a smooth surface and a fibrous finish.

The combination of either plans A and B or C and D in pick-and-pick, or thread-and-thread grouping, give *weft* and *warp*-backed structures, as shown in weaves A^3 and C^1. The crossings A^4 and A^5, derived from twills A and B, are typical of the "satara" and "stockingette" builds of fabric, which may also be acquired by similarly grouping the picks and threads

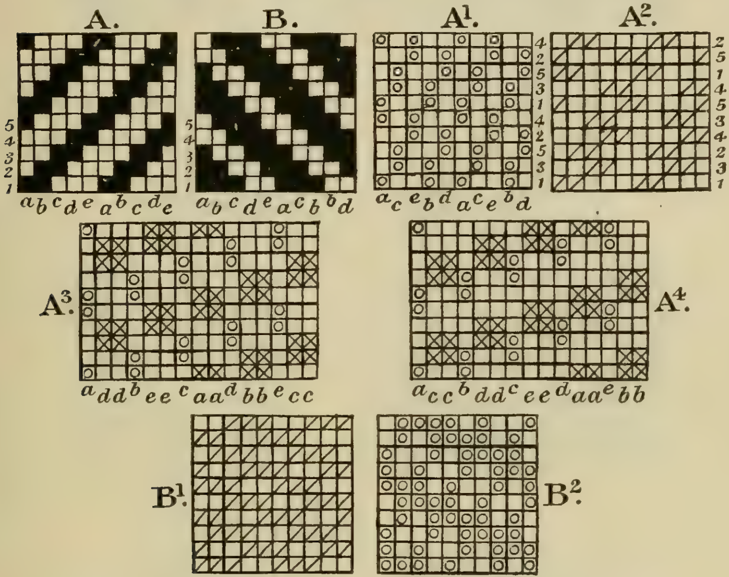


FIG. 74.—EXAMPLES IN FIVE-END TWILL DERIVATIVES.

of weaves C and D. The "satara" is a cloth with the cutting lines weftways. If these run in the direction of the warp, as in Plan C^1, a "stockingette" effect is produced. Both types of make are usable in reversible fabrics.* Employing the 2-ply *warp* structures (Fig. 73, A^5 and C^1) the warp yarns conceal the shots of weft, and employing the same weaves, turned round, and converting them into 2-ply *weft* structures, causes the shots of weft to conceal the threads of warp. Faced-finished costume cloths (Saxony woollen or Botany worsted), are producible in either of these systems of weave-planning. On economic

* See *Standard Cloths: Structure and Manufacture.*

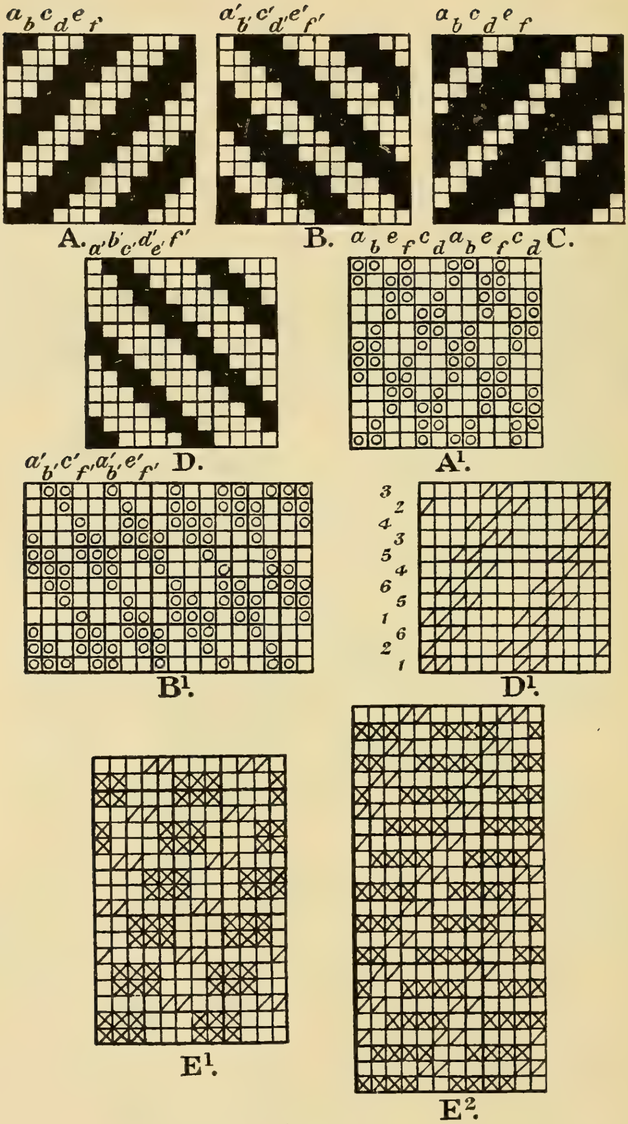


FIG. 75.—EXAMPLES IN SIX-END TWILL DERIVATIVES.

weaving grounds, the warp practice has advantages, and is requisite if a "stockingette" kind of cloth is intended. On the other hand, if cotton yarns are used in the warp, and crossed with woollen or Botany worsted yarns, and the "satara" effect is desired, the weave essential is that formed on the reversible weft principle.

148. *Balanced Twill Effects.*—Textural effects from weave types may be readily designed by selecting twills in which the warp and weft interlacings either coincide in size or approximately balance each other on the two surfaces of the cloth, that is, such twills as $\frac{2}{2}$, $\frac{3}{2}$, $\frac{3}{3}$, $\frac{4}{3}$, $\frac{4}{4}$, $\frac{5}{4}$, etc. In addition, twills occupying 10, 11, 12, or more threads and picks, and also twills of a larger construction (on 16 to 24 shafts) and varied in the lines of warp and weft, are also extensively utilized for re-arrangement purposes, but these are mainly applicable to special grades and descriptions of cloth. Examples in the weave units, derived from the more ordinary classes of twills, are illustrated in Figs. 72 to 78 inclusive. The scheme of weave-planning, varied in the origination of each effect, as well as the basic weave from which the effect has in each instance been obtained, are defined in Table X.

TABLE X

Derivatives of Twilled Weaves

Twilled Base.	Order of Thread or Pick Transposition or Grouping.	Derivative Types.
Fig. 72A, $\frac{2}{2}$ Twill or Cassimere	Plan A[1]—Duplicated in the picks	Upright Twill
	„ A[2] „ „ threads	Oblique Twill
	„ A[3] „ „ „ and picks	Step Twill
	„ A[4]—Picks 1, 2, 4, 3	Weave cutting two's in the weft
	„ A[5]—Threads *a, c, b, d*	Weave cutting two's in the warp
	„ A[6] „ *a, c, b, d, c, a, d, b*	Granite Twill, angle 15°
Fig. 72B	Plan B[1]—Picks 1, 2, 4, 1, 3, 4, 2, 3	Granite Twill, angle 60°
Fig. 72A and B	„ C[1]—Alternate picks of A and B	Irregular Make
„ „	„ C[2]—Alternate threads of A and B	„ „

TABLE X—(*contd.*)

Twilled Base.	Order of Thread or Pick Transposition or Grouping.	Derivative Types.
Fig. 73A, ${}^{3}_{1}$ Twill, Warp-face	Plan A¹—Duplicated in the picks	Upright Warp-face Twill
	,, A² ,, ,, threads	Oblique Warp-face Twill
Fig. 73B, ${}^{1}_{3}$ Twill, Weft-face	,, B¹ ,, ,, picks	Upright Weft-face Twill
	,, B³ ,, ,, threads	Oblique Weft-face Twill
Fig. 73A and B	,, A³—Alternate picks of A and B, both twilled to the right	2-ply Weft-face Twill
,,	,, A⁴—Alternate picks of A and B, twills in reverse direction	2-ply Weft-face Weave.
,,	,, A⁵—Alternate threads of A and B, twills to the right	2-ply Warp-face Twill
Fig. 73C, ${}^{2}_{1}$ Broken Twill, Warp-face, and Fig. 73D Broken Twill, Weft-face	,, C¹—Alternate threads of C and D	2-ply Warp-face broken "swansdown"
Fig. 74A, 5-end Twill	Plan A¹—Threads *a, c, e, b, d*	Venetian Twill
,,	,, A²—Picks 1, 3, 2, 4, 3, 5, 4, 1, 5, 2	Whipcord
,,	,, A³—Threads *a, d, d, b, e, e, c, a, a, d, b, b, e, c, c*	Mat and Twill
,,	,, A⁴ ,, *a, c, c, b, d, d, c, e, e, d, a, a, e, b, b*	Fancy Twill
Fig. 74B, ${}^{2}_{3}$ 5-end Twill	,, B¹—Picks 1, 3, 5, 2, 4	Weft Twill
	,, B²—Threads *a, c, b, d, c, e, d, a, e, b*	Step Twill
Fig. 75A, ${}^{3}_{3}$ Twill	Plan A¹—Threads *a, b, e, f, c, d, a, b, e, f, c, d*	Twill, cutting 2's in the Warp
Fig. 75B, ${}^{3}_{3}$ Twill to the left	,, B¹— ,, *a′, b′, c′, f′, a′, b′, e′, f′, a′, d′, c′, b′, c′, b′, d′, b′, a′, f′*	Twill, cutting 3's in the Warp
Fig. 75D, ${}^{4}_{2}$ Twill to the left	,, D¹—Picks 1, 2, 6, 1, 5, 6, 4, 5, 3, 4, 2, 3	Whip Cord
Fig. 75 A and D	,, E¹— ,, 1A, 1A, 3D, 2A, 2A 2D, 3A, 3A, 1D, etc.	Mat Twill
,, 75 C ,, D	,, E²— ,, 1C, 4D, 2C, 2D, 3C, 1D, etc.	Weft-Cord Twill

TABLE X—(*contd.*)

Twilled Base.	Order of Thread or Pick Transposition or Grouping.	Derivative Types.
Fig. 76A, $\frac{4}{3}$ Twill	Plan A¹—Threads *a, e, b, f, c, g, d*	Corkscrew or Warp-Cord Twill
	„ A³—Picks 1, 5, 2, 6, 3, 7, 4	Weft Corkscrew
Fig. 76 C and D	„ C¹—Threads arranged alternately or thread and thread of C and D	Modified Warp Corkscrew
„ 76 A „ D	„ C³—Threads arranged alternately 2 ends of A and 1 end of D.	Compound Twill
Fig. 76D	„ D¹—Threads *a′, f′, d′, b′, g′, e′, c′*	Fine Whipcord
Fig. 77A, $\frac{4}{4}$ Twill	Plan A¹—Picks 1, 3, 7, 1, 6, 7, 3, 5	Step Twill, cutting 2's
Fig. 77B, $\frac{4}{4}$ Twill to the left	„ B¹—Threads *a′, a′, c′, c′, g′, g′, a,′ a′, e′, e′, g′, g′, c′, c′, e′, e′*	Open Twill, mat character
Fig. 77C, $\frac{1\ \ 3}{3\ \ 1}$ Twill	„ C¹—Picks 1, 4, 7, 2, 5, 8, 3, 6	Crêpe Twill
	„ C²—Threads *c, b, d, c, e, d, f, e, g, f, h, g, a, h, b, a*	Elongated Twill
Fig. 77D, $\frac{1\ \ 3}{2\ \ 2}$ Twill	„ D¹—Threads *a, d, g, b, e, h, c, b*	Twilled-mat
„	„ D³ „ *a, h, b, a, c, b, d, c, e, d, f, e, g, f, h, g*	Elongated Twill
Fig. 78A, $\frac{5}{4}$ Twill	Plan A¹—Threads *a, f, b, g, c, h, d, i, e*	9-shaft Corkscrew
„	„ A² „ a, *b, f, g, b, c, g, h, c, d, h, i, d, e, i, a, e, f*	Twill skipping in 2 threads
Fig. 78B, $\frac{1\ \ 3}{3\ \ 2}$ Twill	„ B¹ „ *a, f, b, g, c, h, d, i, e*	Oblique Twill
Fig. 78C, $\frac{1\ \ 2\ \ 1}{3\ \ 1\ \ 1}$ Twill	„ C¹—Picks 1, 6, 2, 7, 3, 8, 4, 9, 5	Crêpe Twill
Fig. 78D, $\frac{1\ \ 4}{2\ \ 2}$ Twill	„ D¹—Threads *a, f, b, g, c, h, d, i, e*	Whipcord inverted

149. *Range of Twill Derivatives.*—It will be observed that, with the enlargement of the weave base, the range of weave derivatives is increasingly diversified. Compare, for example, the plans acquired from the 4-end and 5-end twills, or those from the 6-end and 8-end twills. The $\frac{2}{2}$ twill units (Fig. 72) are of a more stereotyped variety than the $\frac{3}{2}$ twill units (Fig. 74), the latter comprising the Venetian A^1, the weft face Venetian B^1, the whipcord A^2, and the open fancy oblique twills A^3 and A^4. Similar forms of weave, as the open makes, are also got by

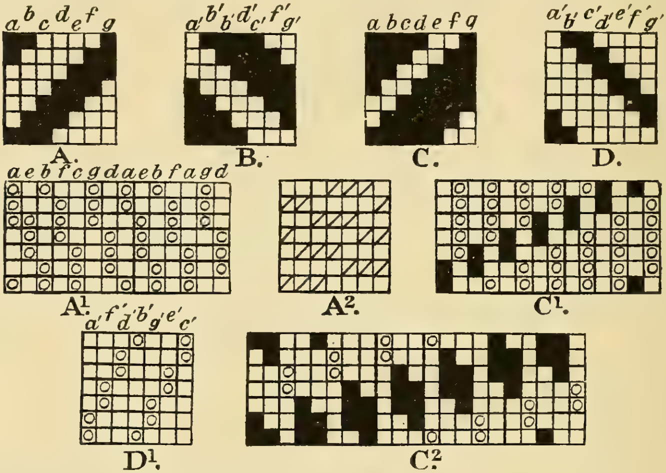


FIG. 76.—EXAMPLES IN SEVEN-END TWILL DERIVATIVES.

following the same systems of thread grouping and using the $\frac{2}{2}$ twill, but less pronounced in the warp effects. The 6-end twill units (Fig. 75), by transposing the threads, include the step twills A^1 and B^1; and, by transposing the picks, the standard whipcord twill D^1; and by combining two picks in a shed of plan A with single picks of plan D, running to the right, a simple variety of diagonal, E^1. The 8-end plans (Fig. 77) are capable of other schemes of elaboration than those illustrated, but clearly these plans are fuller in intersection details than those comprised in Fig. 75. With the possibility of changing and diversifying the lines in the basic twill, as seen at C and D

(Fig. 77), the re-arrangement of the ends or picks gives the twilled mat D[1], and the crêpe twill C[1], and also the elongated and compound twills C[2] and D[2].

150. *Points in the Construction of Derivative Plans.*—Other points for consideration are (1) the different classes of weave structures as derived from plans on an even and odd number of threads respectively; (2) the principles of weave

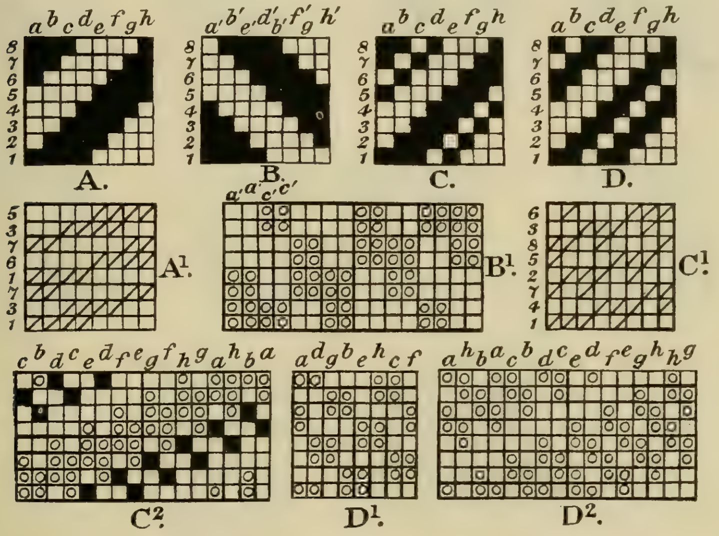


FIG. 77.—EXAMPLES IN EIGHT-END TWILL DERIVATIVES.

formation common to twills generally; and (3) the methods practised in acquiring a new or distinctive type of crossing from a particular twilled weave.

(1) In using twills composed of 5, 7, 9, 11, etc., threads, weaves of a twilled warp or weft cord class may be correctly formed, as in A[1] and A[2] (Fig. 76), which are also made by the same system of thread or pick transposition on 9 and 11 shafts, by employing the $\frac{5}{4}$ and the $\frac{6}{5}$ twills. Further, this variety of cord or corkscrew plan is also formable in twills consisting of an even multiple of threads, but the effects, due to the warp interlacings, are less accentuated as compared with those due

to the weft intersections. This might easily be proved by producing plans of a like arrangement to C² (Fig. 76), using plan A (Fig. 75), and to A¹ (Fig. 78), using plan A (Fig. 77). One system of weave definition, in employing the even-thread twills, not applicable to twills of an odd number of threads,

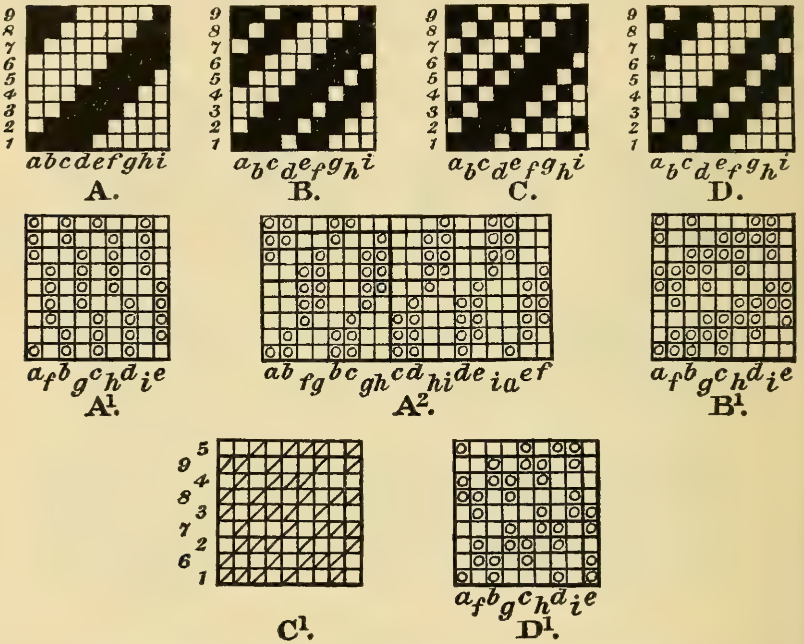


FIG. 78.—EXAMPLES IN NINE-END TWILL DERIVATIVES.

is that of cutting the original twill into equal sectional parts; thus, in constructing plans A¹ and B¹ (Fig. 75) twill A is divided into thirds and halves, and these fractional parts are combined on an extended twill base. The 8-shaft twill, A (Fig. 77), is divisible into fourths as well as halves; and 10-shaft twills into fifths, and 12-shaft twills into sixths, fourths, and thirds, in addition to halves. While, however, equal parts of odd-thread twills are not ascertainable, the threads or picks may be grouped in two's, three's, etc., and in corresponding sections as in the weaves referred to; but the system of construction,

in this instance, results in the acquired weave being composed of a similar number of threads as that obtained by multiplying the threads in the twill selected by the number of threads in the motive applied; for example, to combine the ends in groups of 2, 3, or 4, using 7 and 9-shaft twills, would give designs on 14, 21, and 28 threads, and on 18, 27, and 36 threads respectively.

(2) All the standard twills are suitable for modification on sateen weave principles of interlacing, which provide the orders of re-arrangement or transposition of the threads or picks in the different twills specified below—

Weave Base.	Sateen Order of Thread or Pick Arrangement		
4-end Twills	Threads or Picks		1, 2, 4 and 3.
5-end Twills	,,	,,	1, 4, 2, 5 and 3, or
	,,	,,	1, 3, 5, 2 and 4.
6-end Twills	,,	,,	1, 3, 5, 2, 6 and 4.
7-end Twills	,,	,,	1, 5, 2, 6, 3, 7 and 4, or
	,,	,,	1, 3, 5, 7, 2, 4 and 6.
8-end Twills	,,	,,	1, 4, 7, 2, 5, 8, 3, and 6.
9-end Twills	,,	,,	1, 6, 2, 7, 3, 8, 4, 9 and 5, or
			1, 3, 5, 7, 9, 2, 4, 6 and 8.
10-end Twills	,,	,,	1, 4, 7, 10, 3, 6, 9, 2, 5 and 8.
11-end Twills	,,	,,	1, 3, 5, 7, 9, 11, 2, 4, 6, 8 and 10, or
			1, 4, 3, 10, 2, 5, 8, 11, 3, 6 and 9.
12-end Twills	,,	,,	1, 6, 11, 4, 9, 2, 7, 12, 5, 10, 3 and 8.

Certain of these methods of re-arrangement are exemplified in Fig. 74, A^1 and B^1; Fig. 76, A^1, A^2, and D^1; Fig. 77, D^1; and Fig. 78, A^1, B^1, and C^1.

(3) The simple twills are also adapted for re-arrangement by taking sectional parts thereof, and running them in a symmetrical plan either in the direction of the warp or weft. A "motive" or "motives," composed of given threads or picks in the twill selected, is first originated. Such "motives" are next worked into a complete design as in A^4 (Fig. 74), C^2 (Fig. 76), and B^1 (Fig. 77).

151. *Elongated Twills.*—Small diagonals or elongated twills are of two categories—(1) elongated in the direction of the warp

line, that is in the picks on the point paper ; and (2) elongated in the direction of the weft line, that is in the threads on the point paper. Elementary examples of these patterns are comprised in certain of the twill derivatives, as at E^1 and E^2 (Fig. 75) and at C^2 and D^2 (Fig. 77). The practice consists in combining two or more simple twills of a suitable scheme of interlacing in pick-and-pick or thread-and-thread order ; or in 2-and-1, 2-and-2, 3-and-1, and 2-and-3, and other systems of combination, the plan of grouping agreeing with the type of effect required in the cloth. Examples of a simple character are reproduced at A, B and C (Fig. 79). These are severally formed of two-weave units, and are contrived on the pick-and-pick basis of plan-onnstruction indicated below—

		Twill Move—
Fig. 79A.		
Odd picks—Weave *a* =	${}_{2}{}^{3}{}_{1}{}^{2}$	One thread for each pick of the two weaves *a* and *b*.
Even ,, ,, *b* =	${}_{1}{}^{2}{}_{1}{}^{3}{}_{1}$	,, ,, ,,
Fig. 79B.		
Odd picks—Weave *a* =	${}_{1}{}^{4}{}_{1}{}^{2}$	,, ,, ,,
Even ,, ,, *b* =	${}_{1}{}^{2}{}_{1}{}^{2}{}_{2}$	,, ,, ,,
Fig. 79C.		
Odd picks—Weave *a* =	${}_{2}{}^{2}{}_{1}{}^{3}$	,, ,, ,,
Even ,, ,, *b* =	${}_{1}{}^{2}{}_{2}{}^{3}$	,, ,, ,,

Transposing the plans and substituting threads for picks, would produce twills elongated in a weft line, while grouping the picks of the respective weave units in such orders as two picks of weave *a* and one pick of weave *b*, or two picks in a shed of weave *a* and one pick in a shed of weave *b* in each example, would further elongate the twilled effect.

Another scheme of plan-making involves the amalgamation of several twilled units in a diagonal form, as in examples D to I, in Fig. 79. These introduce additional principles in design-planning, both in the order of composition and in the

selection of weave elements of a suitable structure. The types illustrated in Fig. 79 are formulated thus—

Fig. 79D,	composed of	$\frac{3}{1}$ twill and $\frac{3}{3}$ warp cord.	Approx. angle	70°
,, 79E	,,	$\frac{1}{3}$ and $\overline{1}\,\underline{3}$ twills.	,, ,,	70°
,, 79F	,,	Sateen and weft Venetian twills.	,, ,,	63°
,, 79G	,,	Sateen, $\frac{2}{3}\frac{1}{1}$ and $\frac{2}{1}\frac{1}{3}$ twills.	,, ,,	63°
,, 79H	,,	$\frac{2}{2}$ twill and Venetian twill.	,, ,,	70°
,, 79I	,,	Venetian, upright and $\frac{1}{3}$ twills.	,, ,,	70°
,, 79J	,,	Plain, mat and lines of warp twill.	,, ,,	75°
,, 79K	,,	$\frac{3}{3}$ and $\frac{3}{1}$ twills.	,, ,,	80°
,, 79L	,,	Weft, corkscrew, and buckskin twills.	,, ,,	70°

152. *Crêpe Effects* (Fig. 80).—The object in the origination of this group of plans is a texture light in character in which the warp and weft threads are frequently and systematically interlaced. The weave should produce, in the first place, a satisfactory build and grade of fabric, and in the second place, a subdued but distinctive class of woven effect. The types of plans sketched at A to F (Fig. 80) are suggestive of the constructive practice in acquiring closeness and fineness of textural grain, and, at the same time, a specific style of weave pattern. Plan A is an intermingled crossing almost plain, but showing faint twillings in the cloth ; B and C are similar to each other in formation, but C yields a faster structure. The twills in C also follow a more oblique line than in B, while the warp elements in the latter tend to develop an indefinite mat quality. Type D is devised on a sateen base containing eight spottings in the weft, and a like number of a smaller size in the warp, with the plain make for the ground. In E and F still clearer twilled lines are developed, retaining the principle of frequency of warp and weft intersection. The use of either cotton or Botany warp yarns, harder twisted than the weft yarns, would develop the twills in E, and the small diamond elements in F. The tensioning of the warp threads in piece

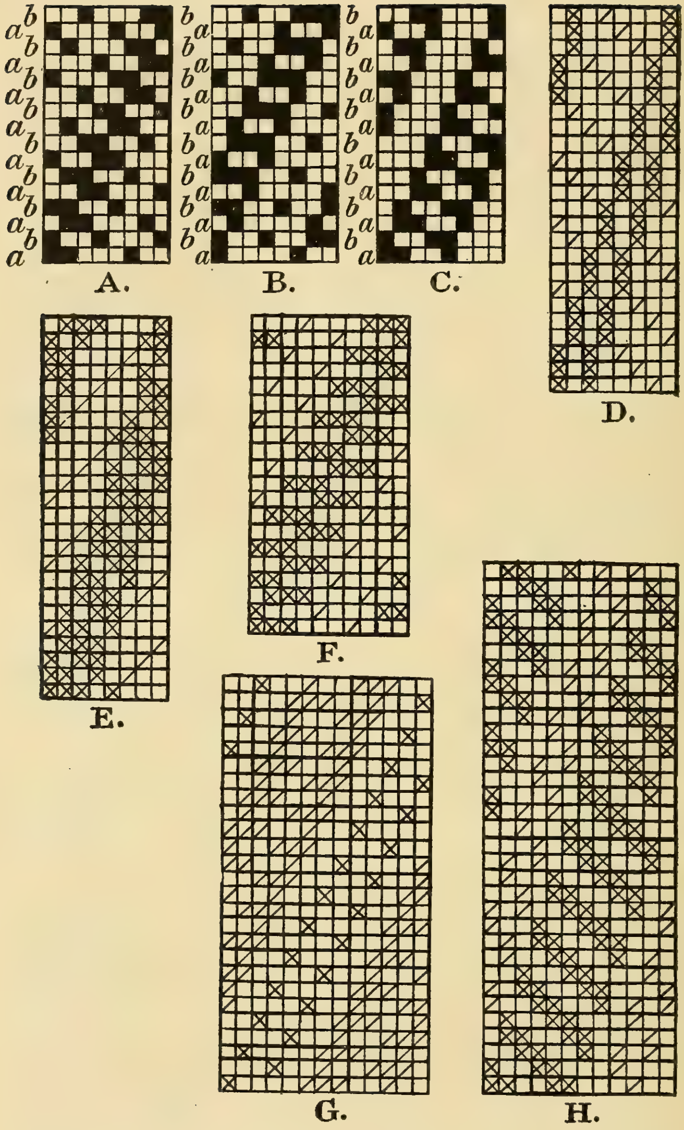
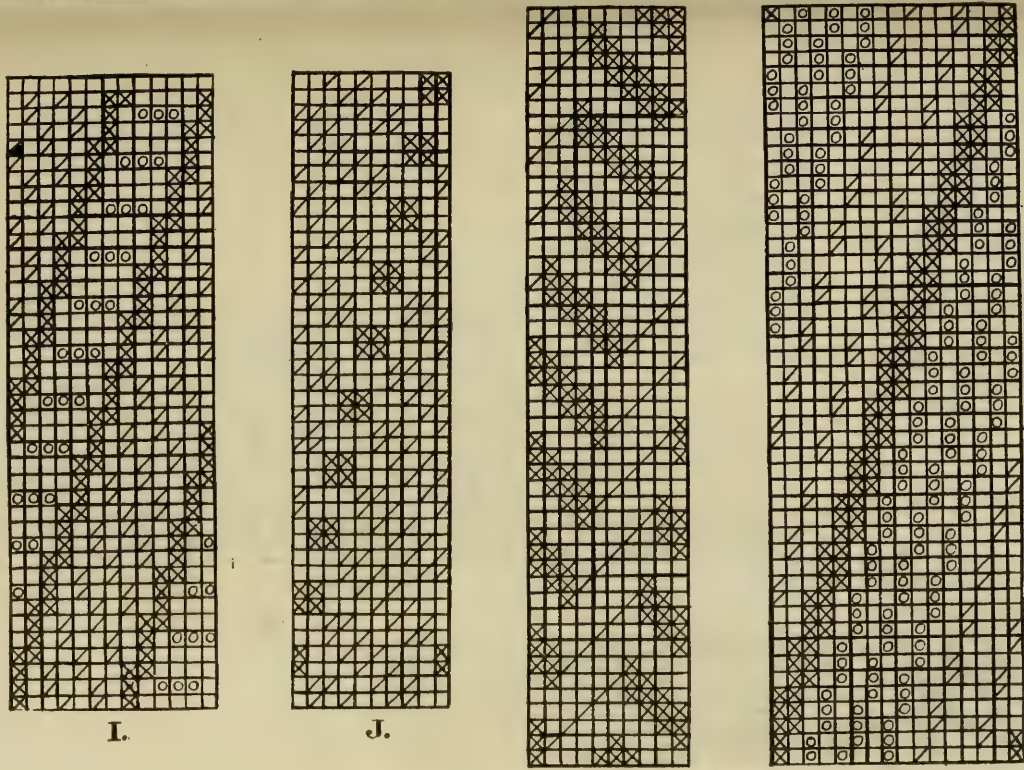


FIG. 79, PLANS A TO H.—EXAMPLES IN ELONGATED DIAGONALS.



I. J. K. L.

FIG. 79, I, J, K, AND L.—EXAMPLES IN ELONGATED DIAGONALS.

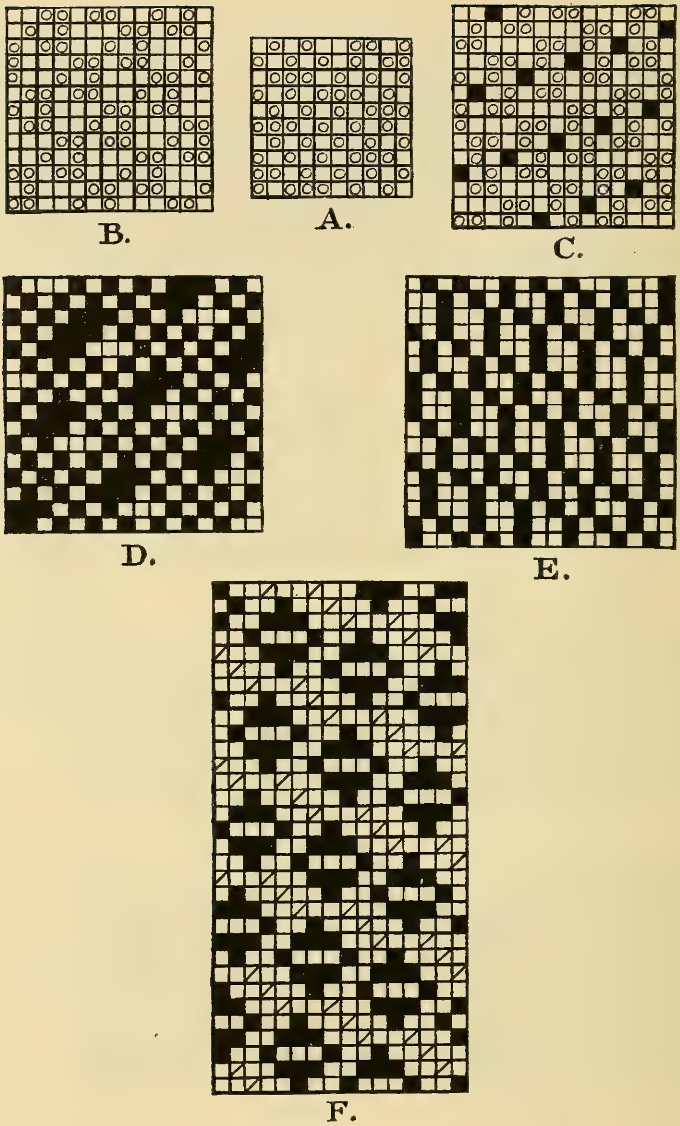


FIG. 80.—EXAMPLES IN CRÊPE WEAVES.

weaving is an important technicality in obtaining the crêpe characteristic in these goods. With the yarns easily delivered from the warp beam, the surface of the cloth becomes of the right formation, but with undue strain on the yarns, the weave features and the crêpe quality of the cloth become less defined. This applies in the application of weaves of this category, whether produced in cotton, silk, or worsted yarns. So-called

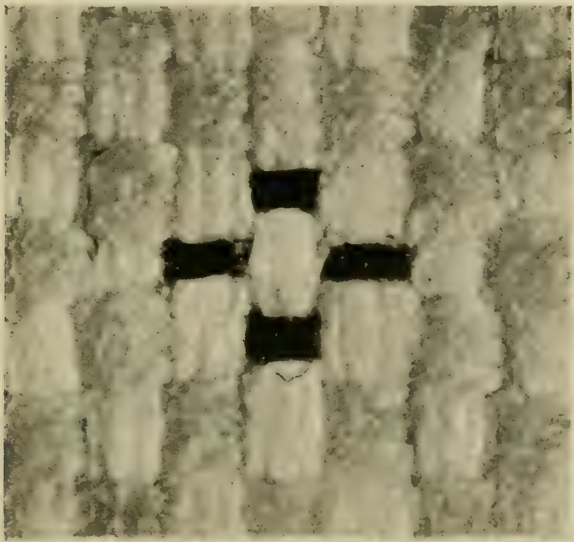


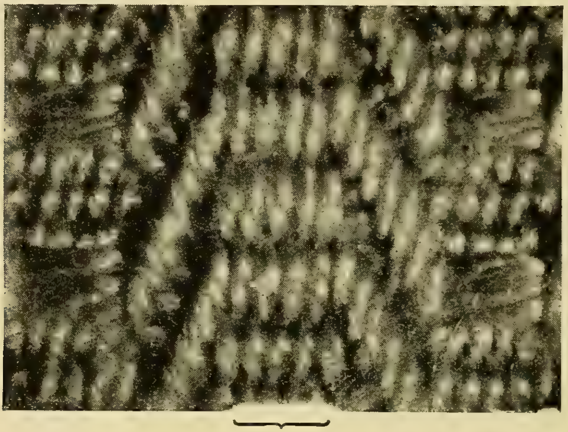
FIG. 81.—THREE-AND-THREE MAT FABRIC-SPOTTED.

sponge cloths are also obtainable in crossings of a similar structure to those in plans D and F.

153. *Warp Cords and Cord Twills* (Fig. 83).—Warp and weft cords or repps have been referred to as derived from the plain weave. *Warp* cords of this class form lines across the texture by one group of threads (1, 3, etc.), and a second group of threads (2, 4, etc.), floating in turn on the two sides of the fabric, as in sections *a* and *b* of plan A^5 (Fig. 70); and the *weft* cords form lines lengthways of the cloth by the odd and even picks successively covering the warp ends as at *c* and *d*

in plan A^6 (Fig. 70). These two kinds of woven effect are seen in stripings *a* of Fig. 84D[1] and in lines *d* of Fig. 54.

The difference in the textural surface thus produced, in forming the effects either in *warp* or *weft*, will be better understood on comparing the specimens in Figs. 81 and 82, one a 3-and-3 mat, and the other, Fig. 82 (section *a*) a 3-and-3 warp cord. In the mat cloth, where the warp threads are brought on to the face, the weft picks float solid underneath them, but in the cord stripe (Fig. 82) odd threads cover the even threads,



a

FIG. 82.

and the latter the former, so that each surface of the fabric is composed of warp yarns. Turning the specimen round, and taking threads for shots and shots for threads, would convert the effect into a weft cord structure, or one in which the odd picks would conceal the even picks and thereby produce a fabric with both sides developed in *weft* yarn. Such principles of fabric building provide for certain descriptions of pattern development by 1-and-1 colouring in the *warp* in simple *warp* cords, and in the *weft* in simple *weft* cords. The striped lustre cloth in Fig. 83 is suggestive of the kind of design features which may in this way be developed. The plain sections of the pattern are woven in 2/40's cotton warp and shuttled with

30's lustre weft, and the apparent mat effects are woven in 4-and-4 warp cord, coloured one thread of black and one thread of white. Under the black threads the white are floated, and under the white threads, the black. The plan

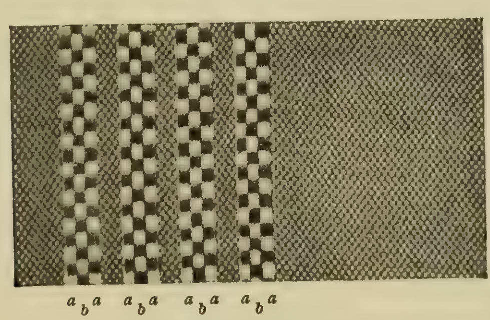


FIG. 83.—LUSTRE STRIPE.

(Fig. 83A) shows how the 4-and-4 war pcords are combined for weaving the stripings in this specimen. The black and white threads in the texture are marked in ☒'s and in ☐'s in the design. As the order of warp is 1-and-1 and the two

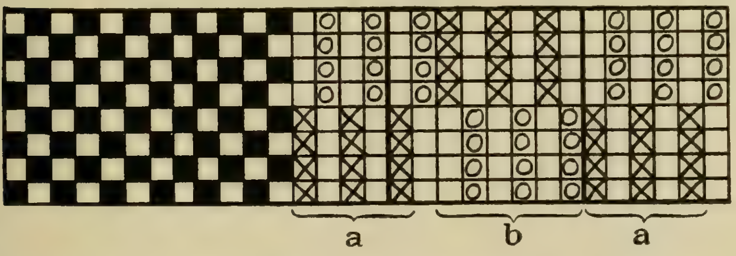


FIG. 83A.—DESIGN FOR SPECIMEN IN FIG. 83.

groups of threads *a* and *b* (Fig. 83A) change positions relative to the colouring, they also alternate the positions of the two yarns on the face and back of the cloth. If the warp arrangement should be altered to one black and one white for 4 threads, and to one white and one black for 4, the weave usable would be the ordinary warp cord This system of pattern-work, and

of cloth construction in repp weaves, is utilized in striping, checking, and figuring, combining *warp* and *weft-face* cord plans.

Strictly, the effects defined are repps, and differ from the cord type of weave illustrated at A, B, and C (Fig. 84). These plans make corded stripes, and combine the effects of a cord and a repp type of cloth. In A, Fig. 84, and also in sections a and a^1 (D Fig. 84) groups of threads interlace plain or prunelle twill on the face, with the weft yarn passing underneath. Plan A shows the correct system of plain repp or cord construction, and the fabric structure is clearly illustrated at Fig. 84A^1. Picks 1 and 3 interlace plain on the face with threads a, and picks 2 and 4 interlace plain on the face with threads b, so that the plain texture made by threads a and the odd picks, cut the plain texture made by the threads b and the even picks, which produces the "cord" stripe. For making a weft line, in combination with the cord stripings, the weaves are arranged as in plans B and C (Fig. 84). Here the even picks, while floating under threads a, as in plan A, cover the four threads in section b, and this gives the weft piping seen in Fig. 54, the design for which consists of 8 threads of plain rib, and 4 threads of weft cord. Plan C is a prunelle-twill cord with weft stripe effect, and plan D a striped prunelle-twill rib stripe, parts a, a^1, and a being combined with a warp cord d. This plan forms the looming design for the pattern in Fig. 84D^1. Twilled ribs may be plain, weft, or warp effect on the face, and composed of one or more weave units. The example E (Fig. 84) is a plain twilled rib, F a weft repp twill, G a compound of weft cord and prunelle twill, and H a compound of warp cord and plain rib, G giving a twilled cord in the weft, and H a twilled cord in the warp.

Corduroy and Bedford cords are an extension of the principle of plain rib weaving illustrated in A, Fig. 84. The unwadded type of plan is that seen in I, Fig. 84, and the wadded type, that given at J, Fig. 84. For acquiring a full rib or cord in this make of cloth, the several ribbed stripes not only cut each other, as

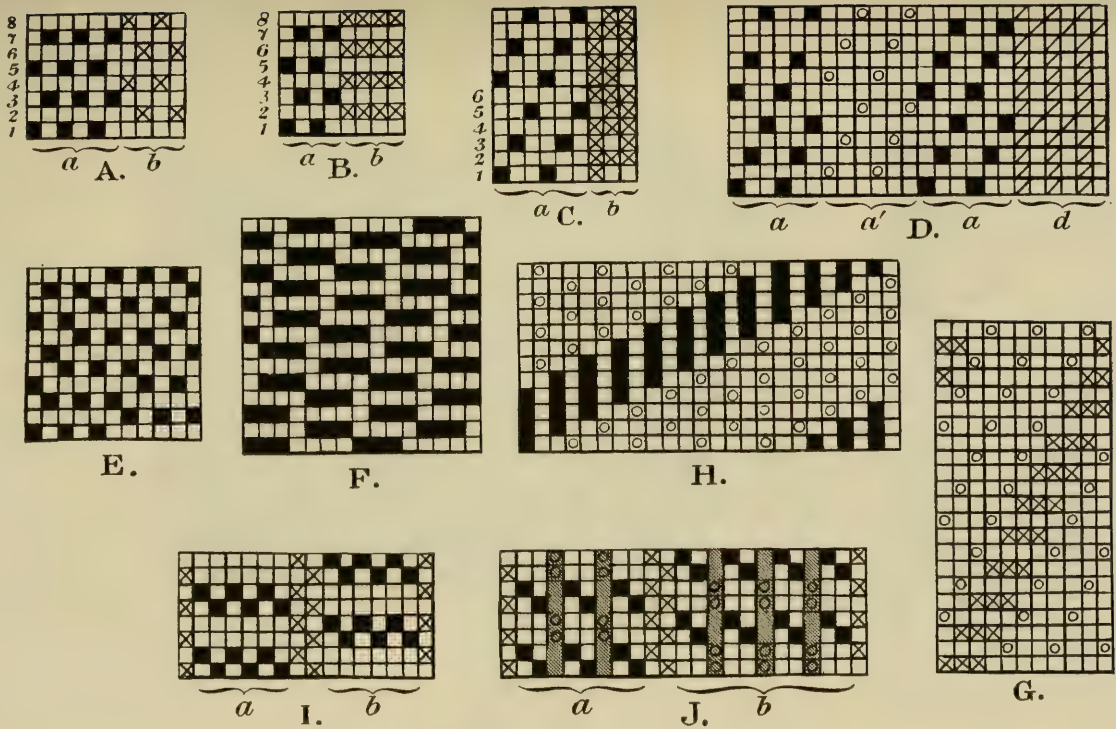


FIG. 84.—EXAMPLES IN REPP OR CORD WEAVES.

in an ordinary cord, but plain interlacing threads—marked in ☒'s in plans I and J—divide one cord from another. It will be observed that picks 1 and 2, and 5 and 6, intersect in plain

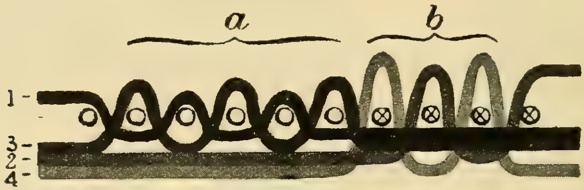


FIG. 84A¹.—PLAN A, FIG. 84.

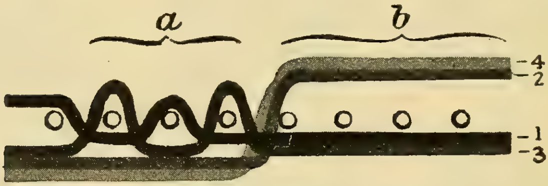


FIG. 84B¹.—PLAN B, FIG. 84.
SECTIONS OF CORD STRUCTURES.

order on the face in section *a* and float underneath the threads in section *b*, and that picks 3 and 4, and 7 and 8, float underneath

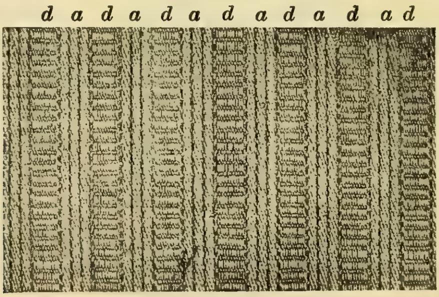


FIG. 84D¹.

the threads in *a* and intersect plain on the face in section *b*. This method of alternately intersecting and floating the two series of picks has the effect of drawing the two groups of threads, composing the ribbed stripes *a* and *b*, into a compact

cord form. The two plain ends, marked in ☒'s and intervening the stripings, develop an indented or cut line lengthways of the cloth. The "wadding" threads, printed in grey in J, Fig. 84, pass between the plain-woven surface and the weft-flushed back of the texture. Such yarns impart fullness to the rib or cord character.

154. *Compound Twills and Diagonals.*—The *diagonal* is a pronounced or bold style of twill composed of lines of different

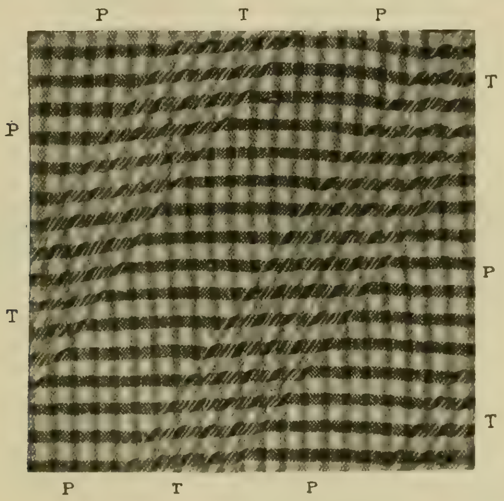


FIG. 85.—CHECKED DIAGONAL.

widths and traversing the cloth at a definite angle. It may be defined as a variety of *twilled* stripe with each sectional part filled in with similar or various weave details. Being thus formed, it may be either a combination of simple or complex weave units. As a rule the weaves should contrast in the textural effects they produce. Fig. 85 is an example consisting of broad lines of plain make in contrast with lines woven in weft twills, that is, of the two weave units seen in the sectional plan (Fig. 85A). Though this dress pattern is warped and wefted 6 threads of white and 6 threads of dark blue, which gives in the plain and twilled parts a plaid or

check, yet the effects due to the diagonal formation are distinctly visible. If portion T of the design is examined, it will be seen that here the checkings in the fabric lose their symmetry of structure, owing to the shots of weft being floated to a larger degree on the face than the threads of warp, whereas in the parts P, the effect of both yarns are alike in character. One result of combining weave units on this principle is the production of a cloth in which the interlacings—however diversified these may be in the plans combined—are equally balanced in the repeats of the woven style; whereas to combine weaves P and T (Fig. 85A) in a striped or checked form would give parts of the fabric in a fast, firm structure and other parts in a loose, open structure. The angle at which the assorted

FIG. 85A.

twills run in the cloth obviates irregularities of this quality in all varieties of diagonal designs.

Four factors have to be taken into account in this class of pattern origination: (1) the capacity of the loom, which determines the scale of the design; (2) the proportionate sizes of the "effect lines" in the pattern; (3) the selection of weaves which harmonize and contrast with each other in textural detail; and (4) the set of the cloth and the yarns of which it is made.

In shaft mountings the scale of the designs, unless drafting is practised in the healding of the warp, is limited to 24, 32, and 36 threads, or to plans of the dimensions seen in Figs. 86, 87, and 88. The two former have the fancy warp mat in common, but Fig. 86 consists of two lines, A and B, with the irregular hopsack line the larger in size; and Fig. 87

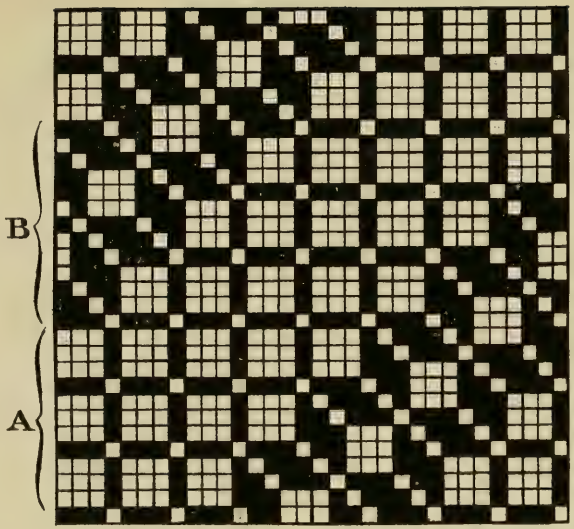


FIG. 86.

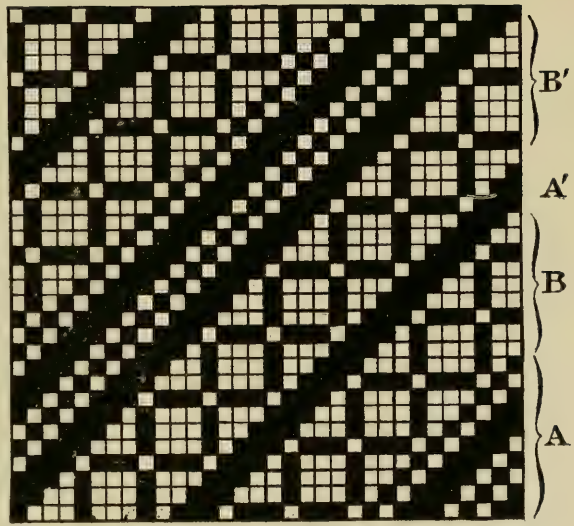


FIG. 87.

EXAMPLES IN DIAGONALS.

consists of four lines , A, A^1, B, and B^1, with the two latter equal in width, with A^1 formed in a single weft twill, and with A in a 6-end twill arranged $\frac{1}{3}\frac{1}{1}$. Here the manner of attaining diversity of style is due to the difference in the structure of the weave elements, and to a variation of " line " breadth.

Fig. 88 suggests the practice of combining warp and weft face weaves (diamond makes) and of separating the two effects from each other by small knitting lines in plain, while Fig. 89 is suggestive of the method of using weaves gradually decreasing in weft floats. For instance, band A is composed of $\frac{1}{5}$, $\frac{1}{4}$, $\frac{1}{3}$, and $\frac{1}{2}$ twills, and band B of the same weaves reversed, namely of $\frac{2}{1}$, $\frac{3}{1}$, $\frac{4}{1}$, and $\frac{5}{1}$ twills. The demarcation between the two effects is again acquired by dividing lines in plain make. For shaded diagonal patterns, either this description of weaves or sateens (Fig. 90) are utilized. The shading does not originate from the use of light and dark tones in the warp and weft yarns, but from a gradation from a maximum to a minimum warp ingredient, as indicated in this example, consisting of 5-end sateen weaves, or of the $\frac{4}{1}$, $\frac{3}{2}$, $\frac{2}{3}$, and $\frac{1}{4}$ crossings. Seven, eight, nine and ten-shaft sateens are also employed on this basis, with the angle of the diagonal running as shown in Fig. 90, or in a more oblique direction, as would be the case by inverting the whole design.

155. *Checkings or Dice Patterns.*—The form of checking here implied is that derived by taking a simple weave unit (twill, irregular mat, etc.), and reversing and transposing it as shown in plans A, B, C, and D (Fig. 91). The effects marked in ■'s make the basic factor in each example. First, this factor is reversed in the picks and turned to the right as at *b* ; second, it is reversed in the threads and similarly turned at *c* ; and, third, detail *d* is obtained by reversing either the threads of *b* or the picks of *c*. Many varieties of neat and effective weave styles are framed in this manner. Simple and fancy twills, or parts thereof, are selected as a " motive " or " motives " of a special design on a fixed number of ends and picks, and then dealt with on this principle.

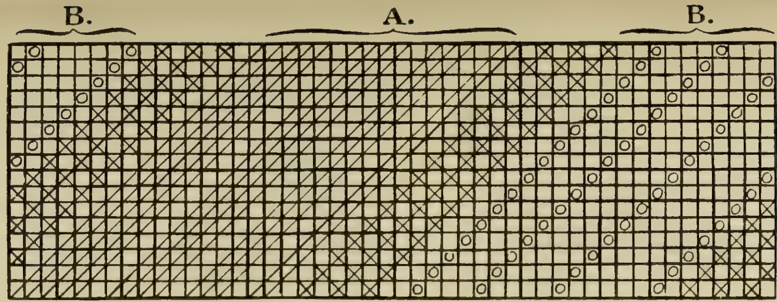


Fig. 89.

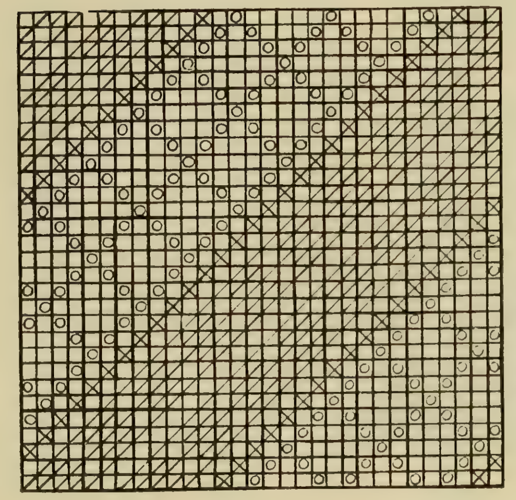


Fig. 88.

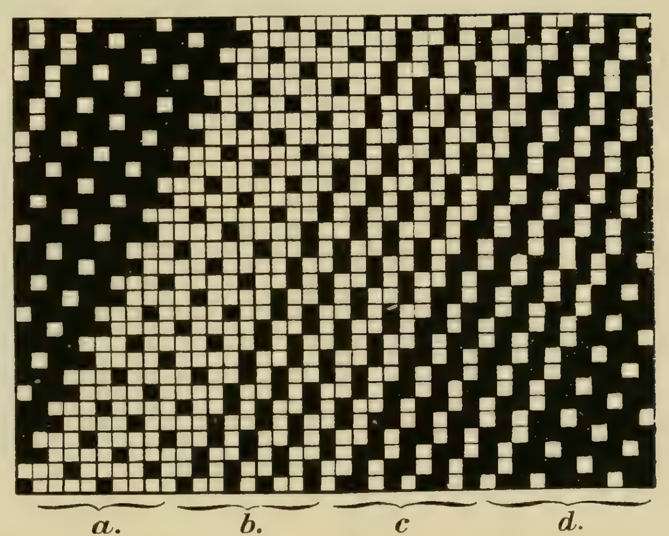


Fig. 90.

Examples in Diagonals.

156. *Waved Effects* (Figs. 92 and 93).—Wave, zig-zag, or serpentine weave patterns, are primarily derived from a twilled base. The waved lines may run in the direction of the warp as at A and C (Fig. 92) obtained from the prunelle and the cassimere twills, or in the direction of the weft as at B and D, and obtained from the $\frac{3}{1}$ and the $\frac{3}{3}$ twills. It should be noted that these differ from " angled " and " herring-bone "

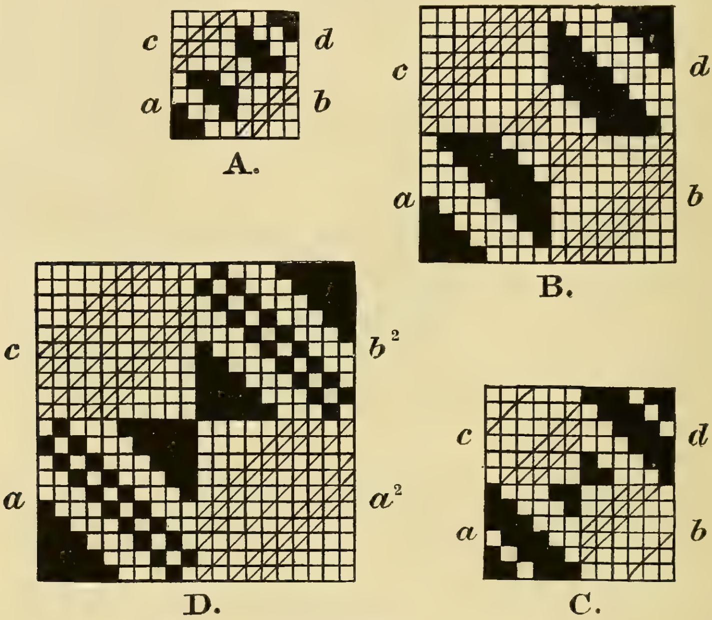


Fig. 91.—Examples in Checking.

twilled stripes, inasmuch as the waved effect is constructed by turning the movement of the twill at a point, whereas in the " angled " patterns, the twill is turned at a juncture which provides for the warp and weft intersections opposing or cutting each other. In addition to the ordinary twills being adapted for this class of design, warp and weft cord twills are also suitable for the production of serpentine or zig-zag, styles as seen in plans E, F, G, and H, composed of A¹ (Fig. 74), A¹ (Fig. 78), and A² (Fig. 76). The size of the bands of which

the wave is formed, and also the size of a repeat of the design, are variable. In E the waved lines consist of 3, and in F of

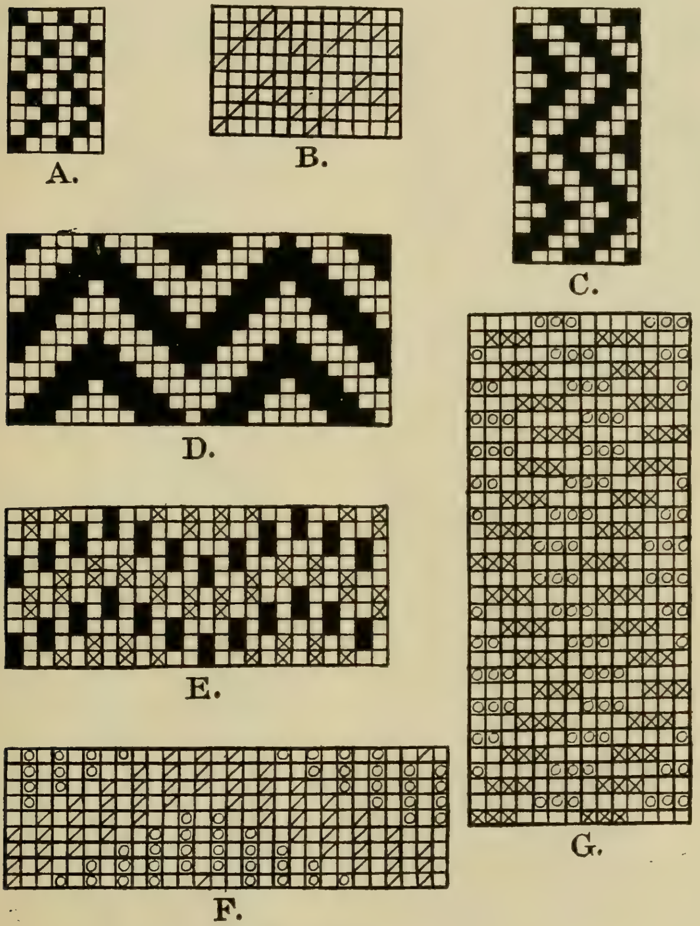


Fig. 92, Plans A to G.
Examples in Waved or Zig-zag Weaves.

5 floats of warp, so that the pattern repeats occupy 12 and 29 threads respectively. Plan H is formed of repp weaves of different sizes.

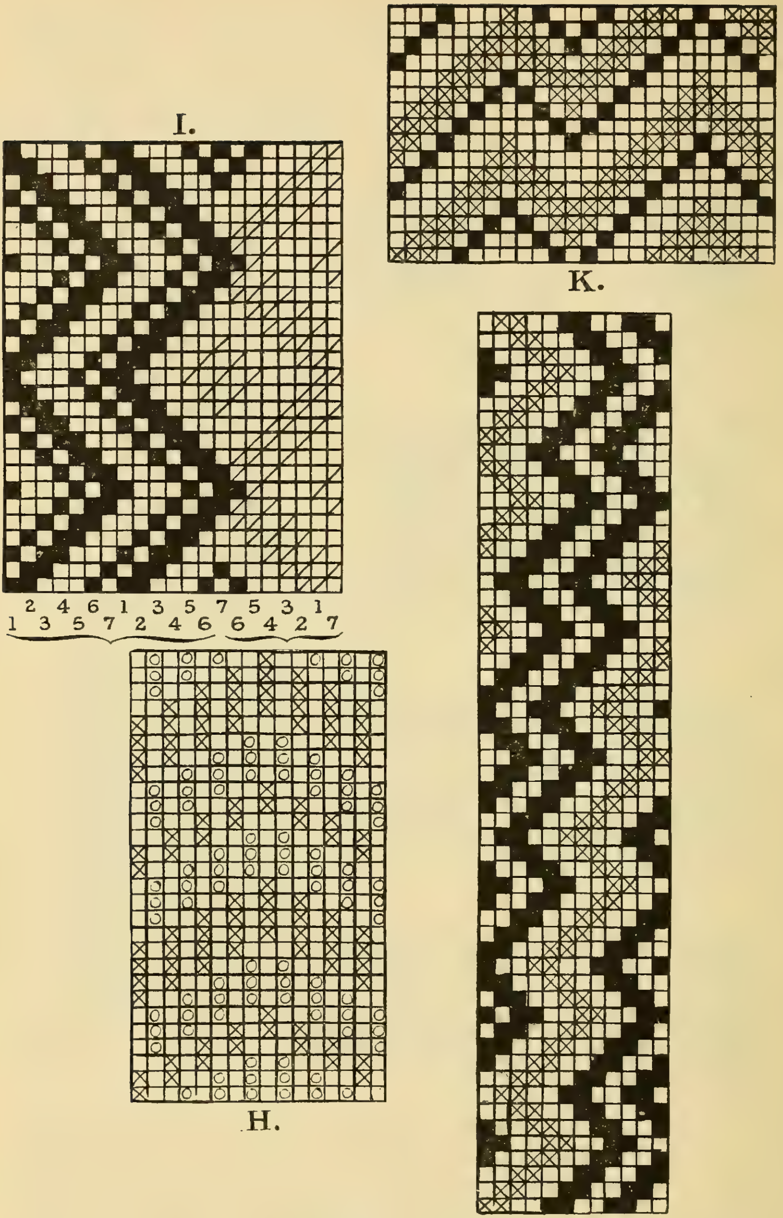


FIG. 92, PLANS I TO J.

EXAMPLES IN WAVED, SERPENTINE OR ZIG-ZAG WEAVES.

Such serpentine lines may be developed in types C and D by using a light warp and a dark weft yarn, and in types E, F, and H by colouring thread-and-thread in two shades of the warp, and in type G, by shuttling 1-and-1 with two colours of weft. Drafting the designs in the order of the numerals at the base of plan I gives a series of waved lines diversified by a striped band in diamond formation. Either the diamond or the serpentine sections are repeatable to give any definite scale of design. Healding the warp, as indicated,

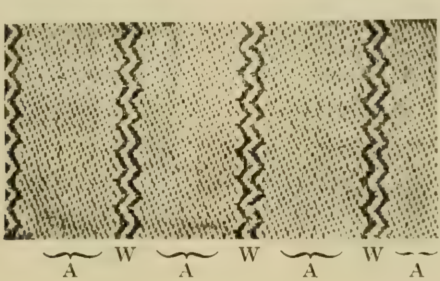


Fig. 93.

involves the employment of the first seven threads in the weave as the reduced or looming design. The zig-zag effect may be worked into a twill or diagonal as in examples J and K, the former being in the $\frac{2}{2}$ twill and the latter in the 8-shaft twill, $\frac{1}{3}\frac{3}{1}$. Waved lines are also used for striping in combination with ordinary twilled weaves on the system shown in the specimen at Fig. 93, where the effects W are produced in weft twill and the effects A in fine warp twill.

157. *Diamond, Diaper, and Lozenge Structures.*—These form a common and useful variety of fabric design. Plans A and B (Fig. 94), developed in warp effects and consisting of the $\frac{2}{1}$ and the $\frac{3}{1}$ twills, are composed of 12 and 16 ends and picks respectively. Patterns of this character are also producible on a larger scale, but, as sketched, they adequately suggest the method of acquiring the diamond pattern in both ordinary and fancy twills. The basic lines of the diamond to be

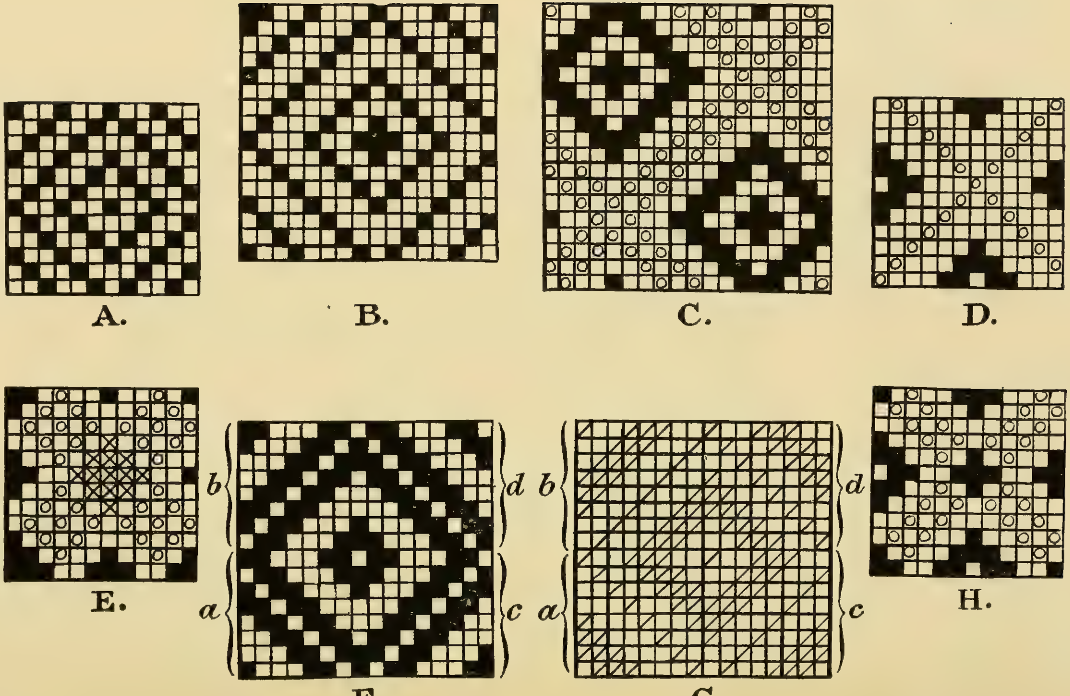


Fig. 94, Plans A to H.
Examples in Diamond Weaves.

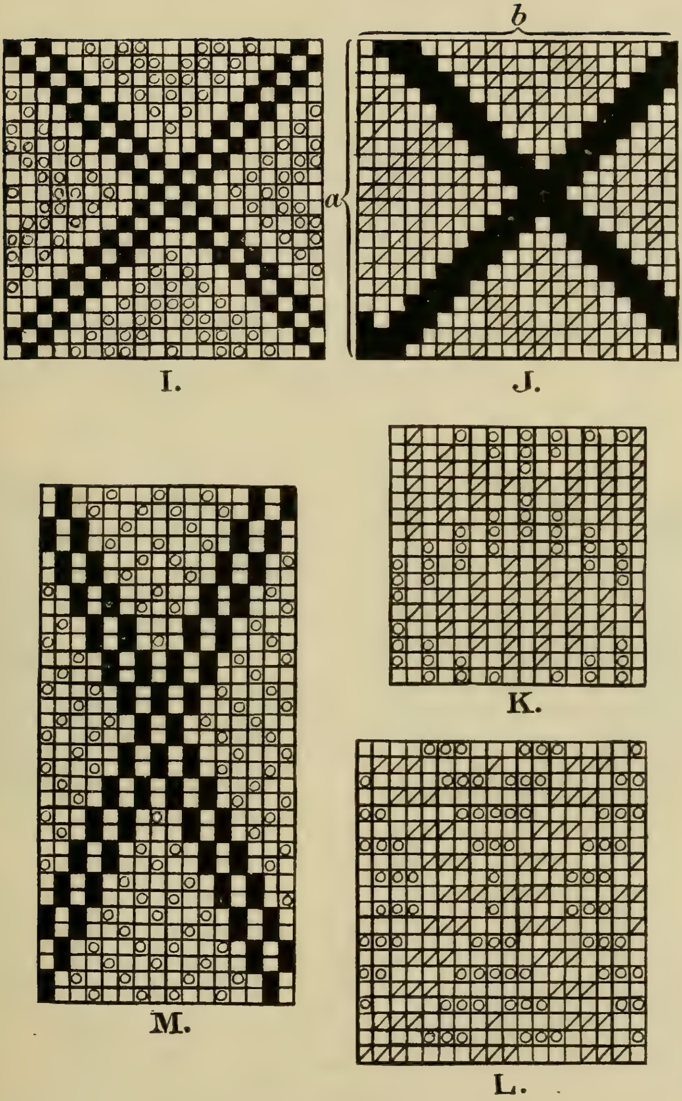


Fig. 94, Plans I to L.
Examples in Diamond Weaves.

originated are first determined, and then these are transposed as in making dice checkings. This principle of work is also followed when the twills are elaborated as in F and G, where section *a*, occupying the first 8 threads and picks, is the weave element transposed at *b*, *c*, and *d*. A further method of

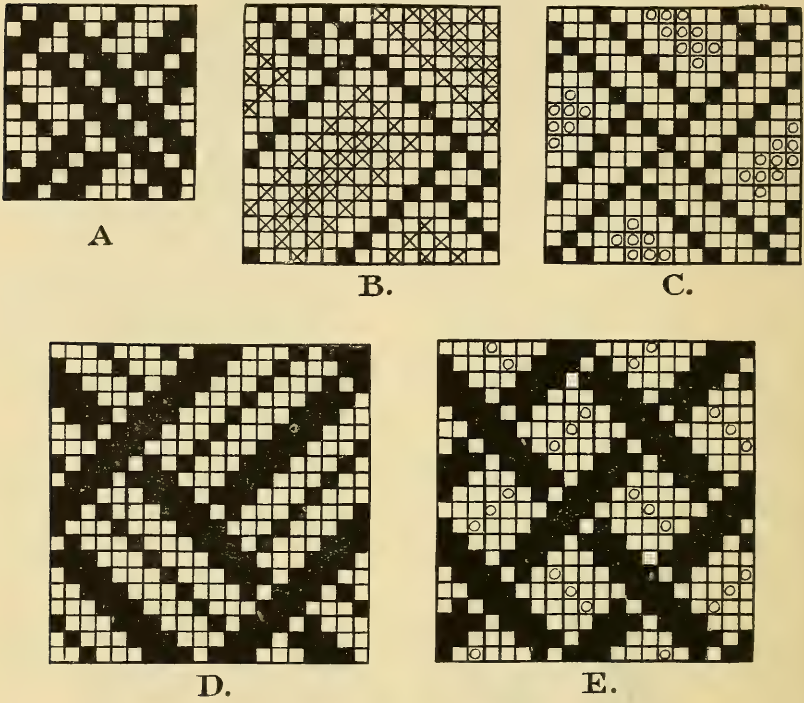


FIG. 95.—EXAMPLES IN TRANSPOSED WEAVES.

construction is to mark intersecting lines centrally on the point paper as in D. This divides the area of threads and picks equally into diamond spaces, which are then filled in with small details as in the portions marked in ■s. The intersecting lines may be duplicated one or more times as at G, H, and I, allowing, in the construction of the design, of the intermediate spaces being composed of a weft spot as at F and H, and of a diamond spot as at I. These lines may be further

formed in weft or fancy twills, e.g. plan J in a 3-weft float twill, with the diamond area composed of intersecting lines, or of lines of warp and weft twills running to the right in section *a*, and to the left in section *b*.

The lozenge is but an elongated diaper or diamond. At K it is made in warp cords and elongated transversely, at L in weft cord and elongated in the direction of the picks. Obviously by using the twills with a "move" of two or several picks for each thread, as at plan M, the elemental lines divide the area of the design into lozenge figures, which are decoratively treated as in the diagonal patterns described.

158. *Transposed Types.*—In devising weaves of this class an "effect" is first formed and then geometrically transposed. In plan A (Fig. 95) the "effect" consists of two simple twilled lines, and in plan B, of a rectangular spot. When such are correctly set in relation to each other, and leaning in opposite directions, they leave a series of threads and picks unintersected. If the "effects" are minute in character, as in plan C, the intermediate or ground spaces may be filled in with supplementary lines, transposed to agree with the basic features. Other schemes of construction are typified at D and E with more pronounced twilled lines. All such principles of patternwork are extensible, and may be further elaborated, in large designs, by the type and variety of the weave elements combined.

159. *Mock Lenos.* (Fig 96).—From this description of crossings, imitation gauze, leno, and more or less perforated fabric structures are obtained. Openness of structure is emphasized by the system of reeding or sleying, vacant dents being allowed between the several groups of threads into which the weaves are divisible. For example, the different plans under Fig. 96 may be sleyed as shown in the table on page 222.

Weaves A, B, and C are made on the same basis, only being modified by the insertion of 2 picks in a shed on shots 3 and 4 and 6 and 7 in plan B, of 3 picks in a shed on shots 2, 3, and 4 and on 7, 8, and 9 in plan C. A looser and more matted

Plans. Fig. 96.	Method of Reeding.
A, B and C	3 threads in a dent and one dent vacant.
D and E	4 ,, ,, ,, ,,
F	Dent (1) threads 1 and 2, one dent vacant. ,, (3) ,, 3, 4, and 5. ,, (4) ,, 6, 7, and 8, one dent vacant.
G	,, (1) ,, 1, ,, (2) ,, 2, 3, 4, 5, and 6, ,, (3) ,, 7, ,, (4) ,, 8, 9, 10, and 11.
H	5 threads in a dent and one dent vacant.

character of fabric is obtained by this principle of intersection than by using type A. Weave B is the standard canvas make; E gives a faint twilled effect, and F a fine checked feature in the texture. In plan G, the warp is floated on the face and the weft on the back between the threads and picks marked in ☒'s, while the intersections in ■'s give a plain central structure. This method of plan-making is shown in another form at H, where sections *b* are the reverse of sections *a*.

160. *Honeycomb Plans.*—Several plans of this category are reproduced at A to I (Fig. 97). They result in a species of cloth resembling in effect and in appearance the structural formation of honeycomb. Their application, in dress fabric weaving and designing, is varied, for the plans may be rendered, by the system of loom-setting practised, useful in the manufacture of cotton, worsted, cotton and silk, linen and silk, and worsted and mercerized cotton goods. Weave construction is carried out on the diamond schemes of plan making, with, however, one series of effects, either warp or weft, similarly or better emphasized than the other. With the enlargement of the plans, and also with the method of grouping the knitting ends and picks surrounding the diamond-shaped

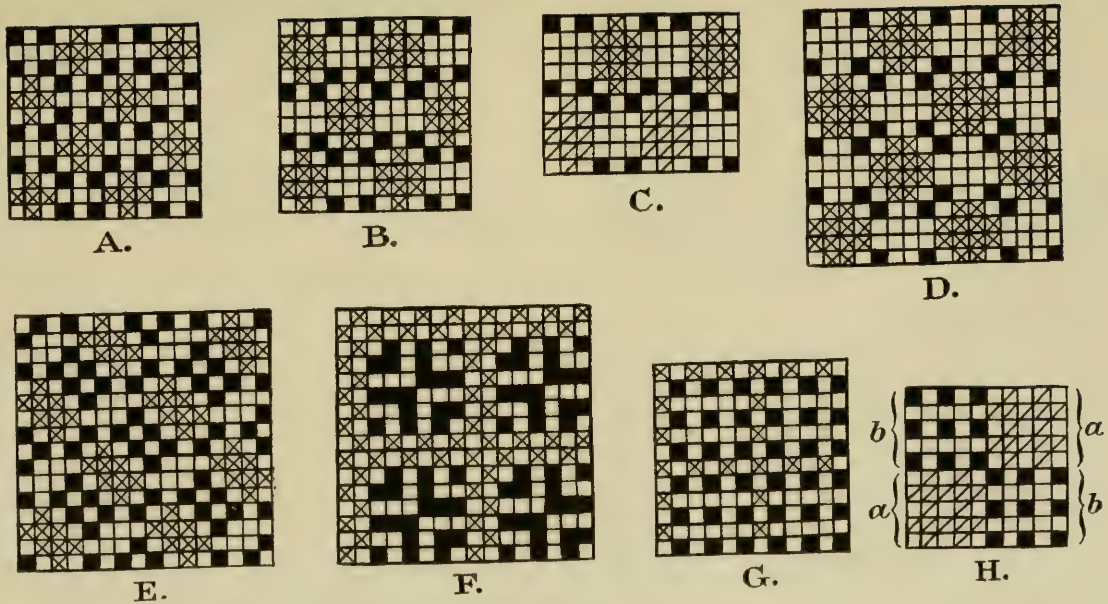


FIG. 96.—EXAMPLES IN MOCK LENO WEAVES.

spottings, the styles obtainable may be considerably modified. In all instances the build of the fabric is comparatively loose or unstable in character, a technicality which is not lessened, but somewhat aggravated by the system of open reeding which is adopted. In the examples, weaves A, B, D, and G are of the standard type, that is, with one diamond figure in weft opposing a similar diamond figure in warp. Weave C is the reverse or underside effect produced by using plan B, and E, the reverse of plan D. Plan F shows the system of adding to the plain details, which would give a stronger build of cloth, but the diamond spottings are not in immediate contact with each other as in C and E. A further elaboration of the structure is given at H in which the diamonds are foreshortened, and picks of weft cord take the place of plain interlacings. This type of design is also made with threads of warp as well as picks of weft cord. The grouping of the effects observed in plan I is the one used in the making of the "Brighton" class of honeycomb.

161. *Huckabacks and Weaves giving a Rough Surface.*—Another description of rough surfaced cloths, only slightly resembling the honeycomb, is acquired in huckaback weaves, such as A and B (Fig. 98). These have generally a plain ground with certain ends and picks floated on the face and on the back of the fabric. The simple form of this weave is given at A, where alternate sections of the plan interchange with sections woven in weft on the face and in warp on the back, with plain interlacings laying between the warp and weft floated yarns. In plan B the effects at *a* are seen reversed at *b*. The reversing of the two structures is, in this example, done in checked order, but it will be understood that the ground of the fabric may be plain, and that the effects in *a* and *b* may be distributed in twilled lines, or they may be arranged on a striped or spotted base. In manufacturing cloths of this kind, the character of the details, due to the weave plan, is well developed by using yarns firm or hard in twine in both warp and weft, whether worsted, cotton, or linen.

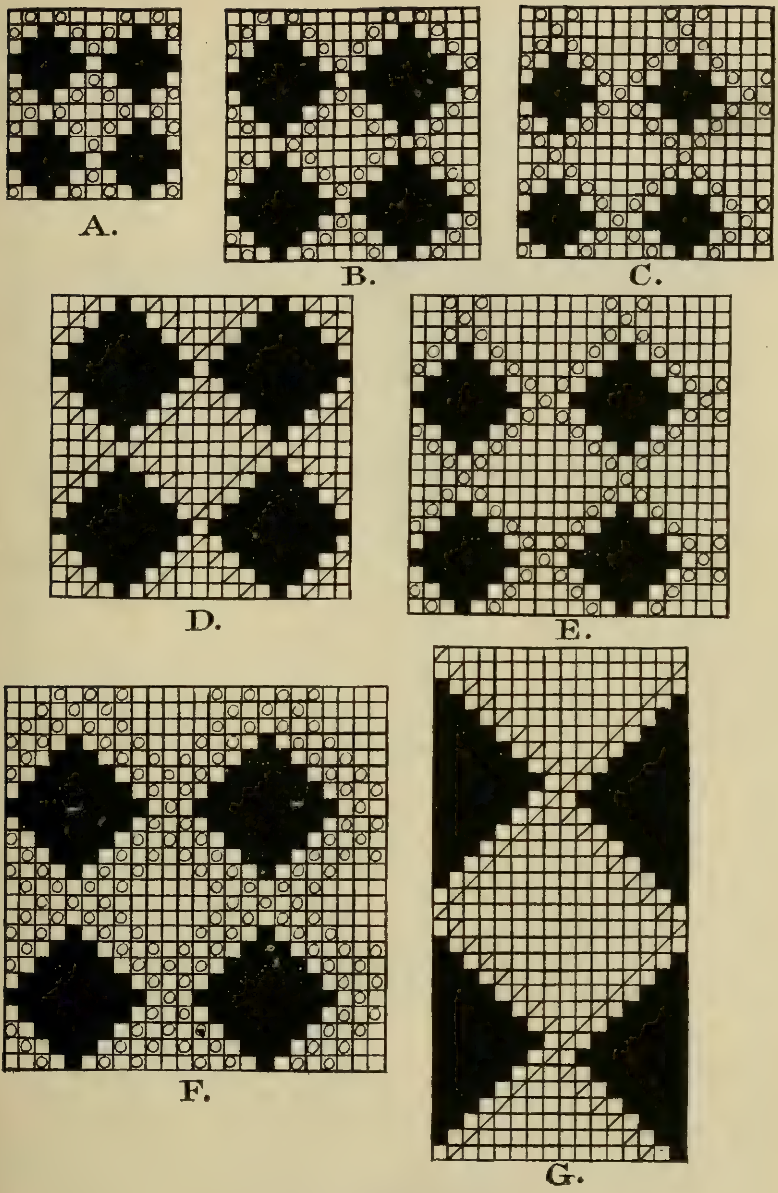
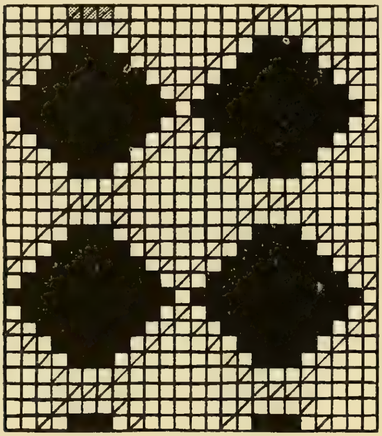
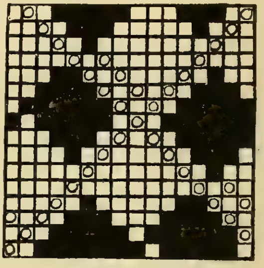


Fig. 97, Plans A to G.
Examples in Honeycomb Weaves.

162. *Sateens.*—For making smooth and even-surfaced fabrics, sateens are the weaves to employ, on account of the intersections of the warp and weft failing to support each



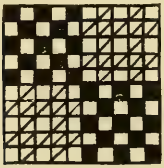
H.



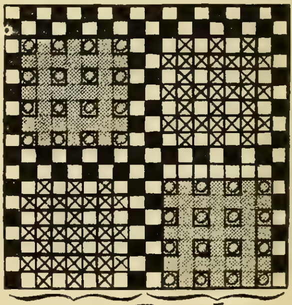
I.

Fig. 97, Plans H and I.—Examples in Honeycomb Weaves.

other, as in the plain make, the common twill, and the mat. The broken $\frac{1}{3}$ twill is regarded as the simplest sateen, but it



A.



a B *b*

Fig. 98.—Huckaback Weaves.

is not strictly a weave of this type, for two out of the four interlacings of which the plan is composed, are in contact with each other, and this is not in accordance with the rule of

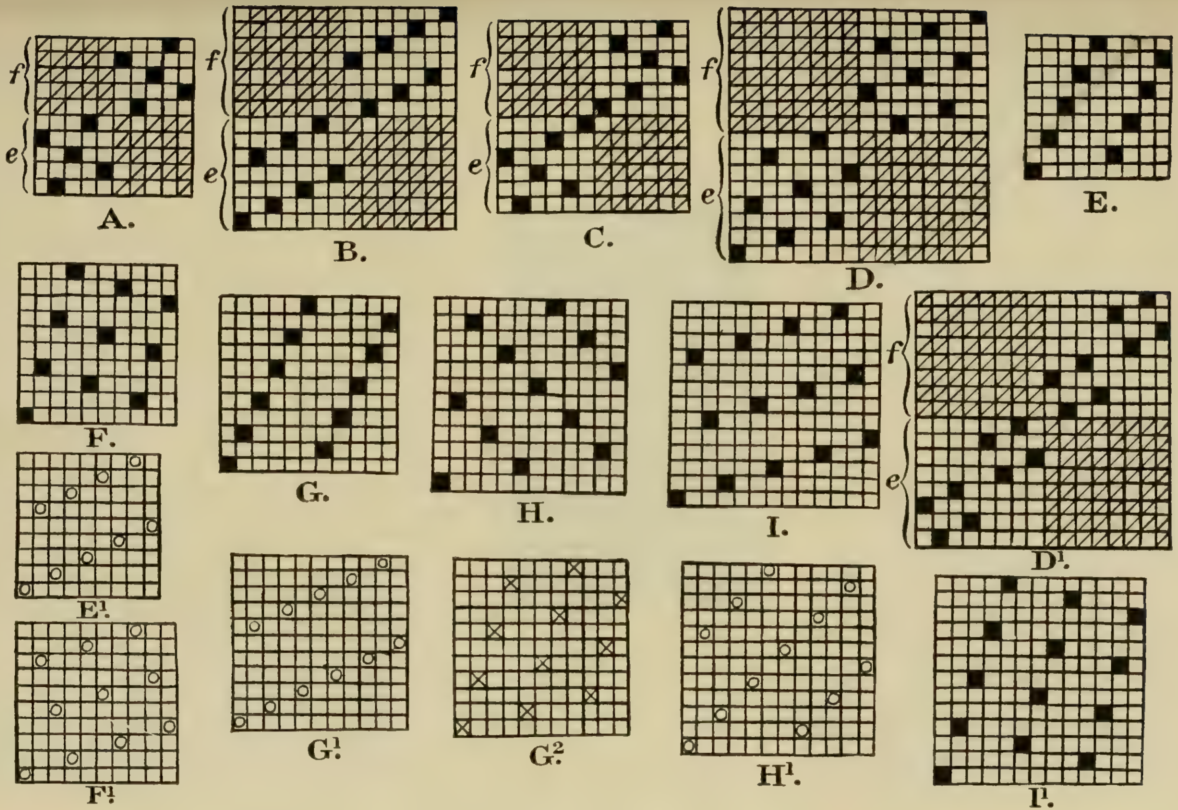


FIG. 99.—SATEENS.

sateen construction, where the intersections are separated by single or multiple threads and picks.

Sateen crossings on 5, 7, and 8 threads are standardized in the silk satin, in the linen, cotton or worsted damask, in the cotton satinette, and in the doeskin or faced-finished woollen or worsted cloth. These several builds of fabric are reproduced in modified forms in dress goods, in which they widely differ in substance and quality with the loom setting applied. As understood, a sateen may result in cloths with either a preponderance of warp or weft on the upper surface, so that in the combination of two sateens such as *e* and *f*,

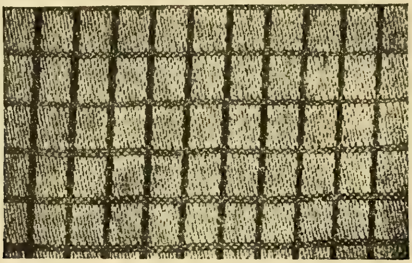


Fig. 100.

plans A to D (Fig. 99), section *e* would yield *warp-face* and sections *f weft-face* effects. This plan of using the two weave units is practised in the production of figured designs as well as of patterns of a spotted, striped and checked composition. The checked linen fabric in Fig. 100 is, for example, obtained in a design consisting of 25 ends and 5 picks of weave *f*, 20 threads and picks of weave *e*, and 5 ends and 20 picks of weave *f* of plan A, Fig. 99.

Textural contrasts in such compound weave styles are clearly defined, the warp and weft surfaces being equally smooth and lustrous, if the threads and picks per inch in the cloth are balanced, and if the warp and shuttling yarns employed are of similar counts and quality. In accordance with the differentiations in these technicalities, special decisiveness of tone

is imparted to either the warp or weft unit in the woven manufacture.

The 6-end sateen is irregular in formation. It should be constructed as at *e* and *f*, plan C (Fig. 99). While not frequently used in the production of piece goods on account of developing a striped twill feature in the fabric—3 threads or picks running to the right, and 3 to the left alternately—yet it is an effective basis for figure arrangement and distribution, in common with the 5-shaft and 8-shaft weaves. The 8-shaft sateen is constructed in two forms, namely, as at D, with the interlacings in regular twilled order, and as at D^1, with the interlacings grouped in sets of four. The latter type is well adapted for duplicated spotted designs on the principles dealt with in Chapter VII. Nine, 10, 11, 12, and 13-shaft makes are given at E, E^1, F, F^1, G, G^1 G^2, H, H^1, and I, I^1. Each plan is capable of being used as a basis of weave origination, for which purpose it is only necessary to add to each intersection mark in the sateen, as illustrated in plans B and E (Fig. 101), made respectively on the 11 and 13-shaft sateens. This method of utilizing the sateen is common in originating weave styles. With the mathematical plan of intersections which the sateen weave provides, the makes built on this basis are necessarily symmetrical in arrangement. Detail changes in the distribution of the supplementary intersections are sufficient to completely modify the character of the weave design acquired. This will be noted on comparing E and F (Fig. 101). The former is based on I and the latter on I^1 (Fig. 99), or on two types of 13-shaft sateens. In making F, five dots have been added to each sateen mark, giving an elongated weft effect ; while in making E, four dots have been added to the sateen base, forming squares of weft, with other intersections running in twilled lines.

Further, weaves of another category are obtained on this system by enlarging the bases themselves either in the picks or in the threads, or by the duplication of both threads and picks. Weaves formed on the first of these principles of

extension, are of an oblique twilled type, on the second of an upright twilled character, and on the third of a fancy mat structure.

163. *Twilled Mats.*—Mats or hopsacks, in which the squares of either warp or weft run in a twilled direction, constitute one of the principal varieties of weave design. They are well adapted for producing cloths level in build and neatly diversified in pattern results. Unlike the common mat, in which the minute rectangular effects are alternately woven in warp and weft floats, these weaves (A to F, Fig. 101) give the mat details in *weft* floats in section *a*, and in *warp* floats in section *b*. The possibility of producing in this way the "mat" in the fabric in the warp or in the weft yarn, renders the crossings applicable to reversible styles of pattern, or cloths in which the effects on the face and on the back, due to either the scheme of interlacing or to the colourings of warp and weft yarns used, are exactly transposed. The weaves are therefore suitable for combination with each other. Taking plan A (Fig. 101) if produced in a light warp and dark weft, the mat interlacings on the face in section *a* would be in dark colour, and in section *b* in light colour. Without, however, using any contrasts in yarn colour, the weaves themselves are sufficiently different from each other, when thus transposed, to produce clear pattern forms. The examples illustrated have the mat spaces, in section *a*, in *warp* effect, and the mat spaces in sections *b* in *weft* effect, and comprise—

Fig. 101A		8-Shaft Twilled Mat		
,, 101B	=	11-Shaft	,,	,,
,, 101C	=	12-Shaft	,,	,,
,, 101D	=	Modified 12-Shaft Twilled Mat		
,, 101E	=	Modified 13-Shaft	,,	,,
,, 101F	=	Elongated 13-Shaft	,,	,,
,, 101C′	=	16-Shaft Twilled Mat		
,, 101F′	=	Modified 16-Shaft Twilled Mat		

These several mats are grouped in striped pattern forms to show the method of weave combination, and also how the types of effect obtainable, in each weave, differ from each other

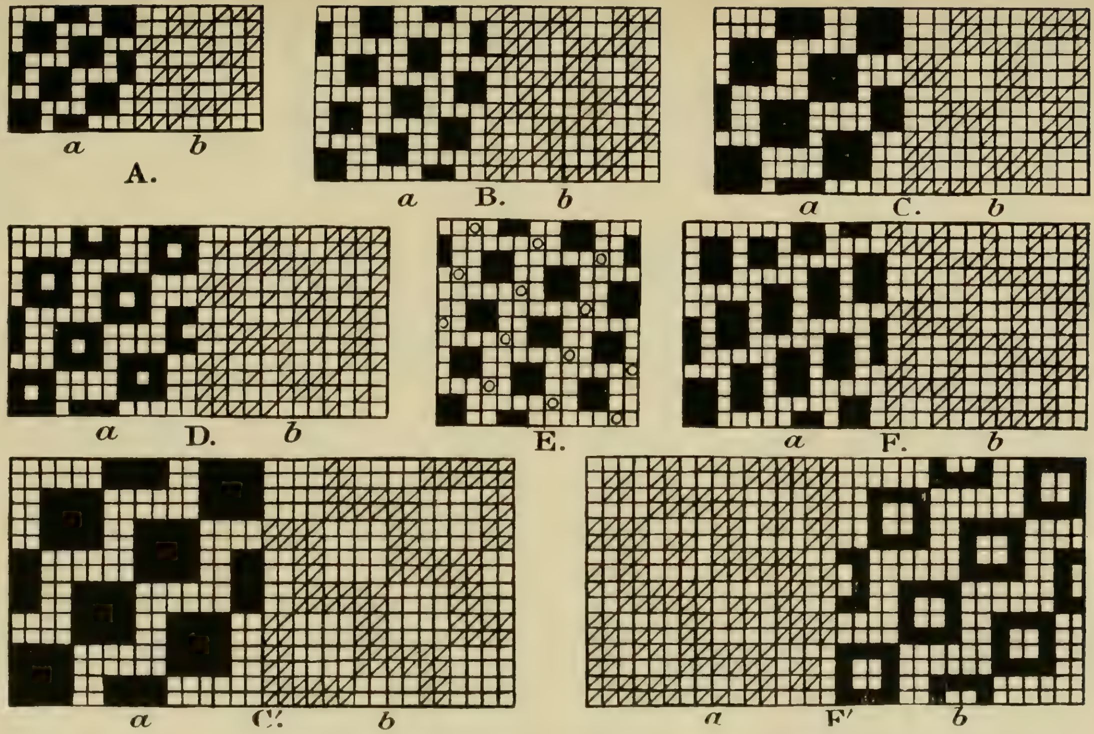


FIG. 101.—EXAMPLES IN WEAVES IN SATEEN BASES.

by developing the mat or hopsack features in *warp* and *weft* interlacings. The modified mats on 12 and 16 threads give a faster build of texture than the mats from which they are derived, but the squares of effect formed are less accentuated than in plans C and C′.

The distinctive and uniform structure of twilled mats, arranged on the sateen base, is evident in these examples. Sateen weaves such as the 10, 14, and 15-shaft units, are also employed in the origination of this class of hopsack, in addition to the weaves as constructed on the 11, 12, 13, and 16-shaft bases, and seen at B, C, D, E, and F in Fig. 101.

164. *Point Paper Plans and Fabric Construction.*—Cloth building and designing, as so far analysed, has been shown to consist in weave origination and in loom-setting. The two factors are inseparable and give to the subject both a theoretical and experimental aspect. The point paper plan is illustrative of the theory of warp and weft interlacing, and the textural product this plan is made to give by the yarn counts and qualities employed, and by the ends and picks inserted per inch in the piece, is representative of the practice in cloth making. In theory, as is evident in the weave bases and types dissected and explained, plans are formable diversified in effect and in scheme of fabric production. These theoretical designs are also varied in manufacturing possibilities. Plans of intersection which prove satisfactory and result in new and successful cloths when correctly set in the loom, result in cloths imperfect in surface and deficient in wearing property, when the setting is disproportionate with the schemes of intersection of which the plans are composed.

There are certain general elements in applying different weaves to all classes of dress, blouse, and costume goods, which have to be considered, such as—

(1) *Warp-face* weaves as a rule provide for fuller setting in the threads than in the picks, and *weft-face* for fuller setting in the picks than in the threads.

(2) Weaves balanced in the warp and weft intersections,

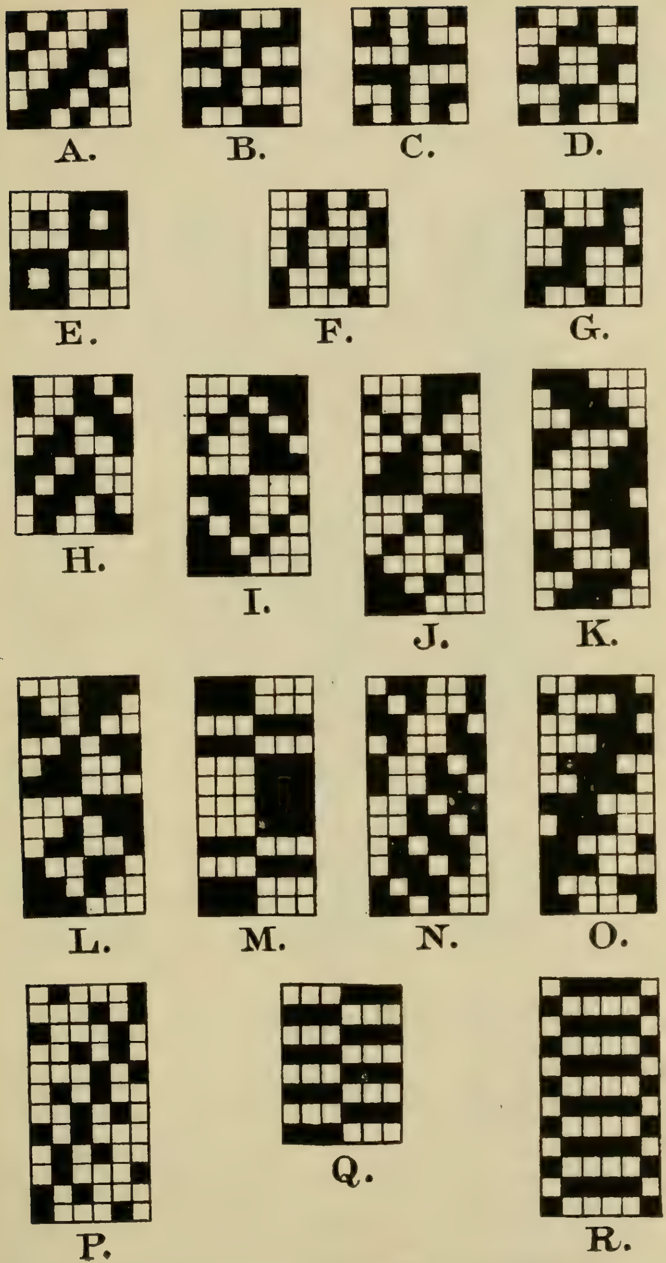


Fig. 102.—Examples in Six-Shaft Weaves.

or nearly so, allow normally of equal setting in both ends and picks per inch.

(3) In acquiring open cloths of a canvas description including loose mat structures and broad textural details, the setting,

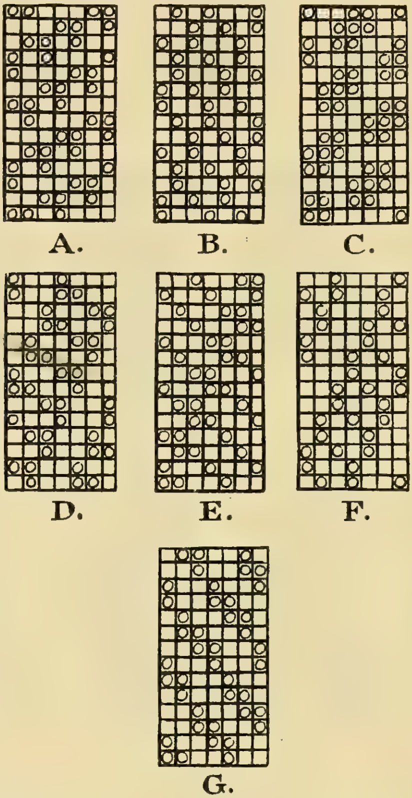


Fig. 103.—Examples in Seven-Shaft Weaves.

should the weave be composed of groups of alternating fast and loose interlacings, as in weaves of the imitation gauze class, should be comparatively loose both in the reeding and in the wefting, but should the weaves be of the type seen at G, H, and J (Fig. 112) fairly firm setting is desired to give stability of fabric construction.

(4) For developing in a special degree the warp details,

as in plan F, Fig. 103 ; A, Fig. 105 ; C, Fig. 109 ; and C, Fig. 111, about 5 to 10 per cent. closer warp than weft setting might be adopted ; but for developing the weft features in a special

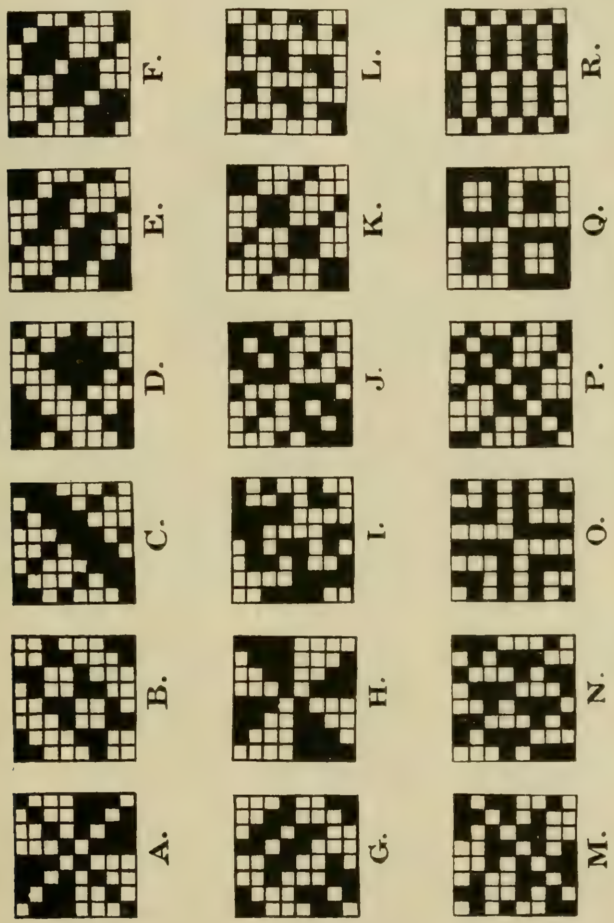
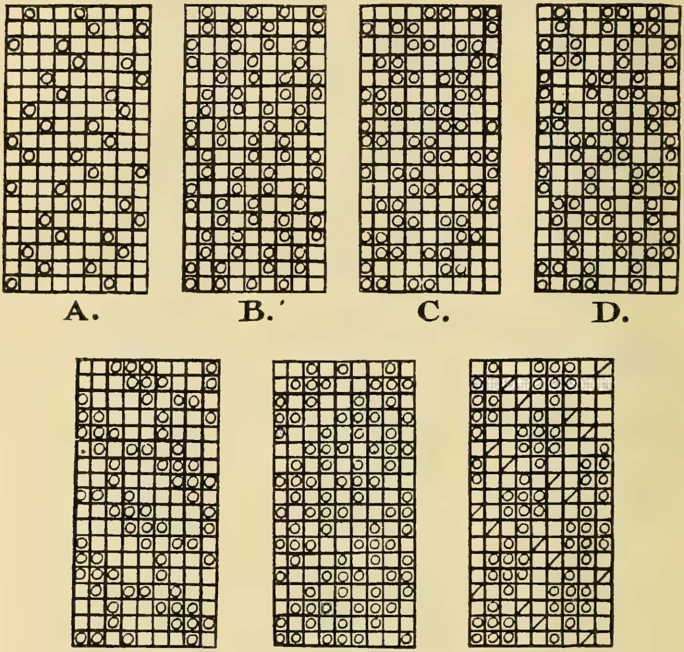


Fig. 104.—Examples in Eight-Shaft Weaves.

degree, the density of threads and picks per inch may be approximately the same, with, however, the weft yarns thicker in counts, as, for example, in producing cloths in plans built on the principles indicated at E (Fig. 108) and D (Fig. 111).

(5) Cloths intended for contraction in finishing, allow of the setting being from $7\frac{1}{2}$ to $12\frac{1}{2}$ per cent. below that ascertained in any particular weave on the yarn diameter and intersection basis, with the pieces proportionately wider in the loom for the standard finished width.



A. B. C. D. E. F. G.

FIG. 105.—EXAMPLES IN NINE-SHAFT WEAVES.

Apart from these radical principles, there are other governing technicalities only realizable and adjustable in so far as experiments are carried out in the loom. The whole subject bristles with difficulties, but the difficulties are exactly of that kind which, in the solving, give types of design yielding effective woven styles.

165. *Weave "Gamut" and Shaft Mountings.*—The study of "weave" design as originated from and elaborated on the

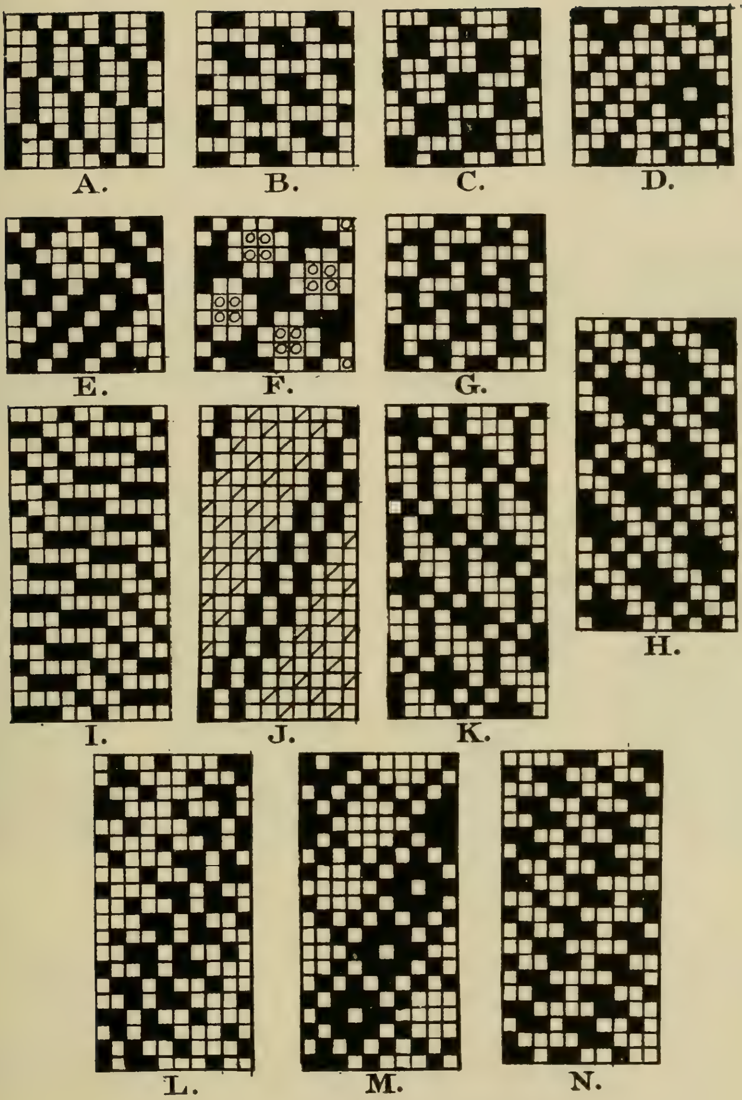


FIG. 106.—EXAMPLES IN TEN-SHAFT WEAVES.

standard bases referred to, exhibits the range of fabric structures capable of being formed by twilling and matting, and in makes of a semi-perforated, sateen, diagonal, honeycomb, and checked order. But these are far from covering the varieties and types of effects obtainable. Each system of shaft mounting offers a gamut of elements for weave-planning, and for cloth

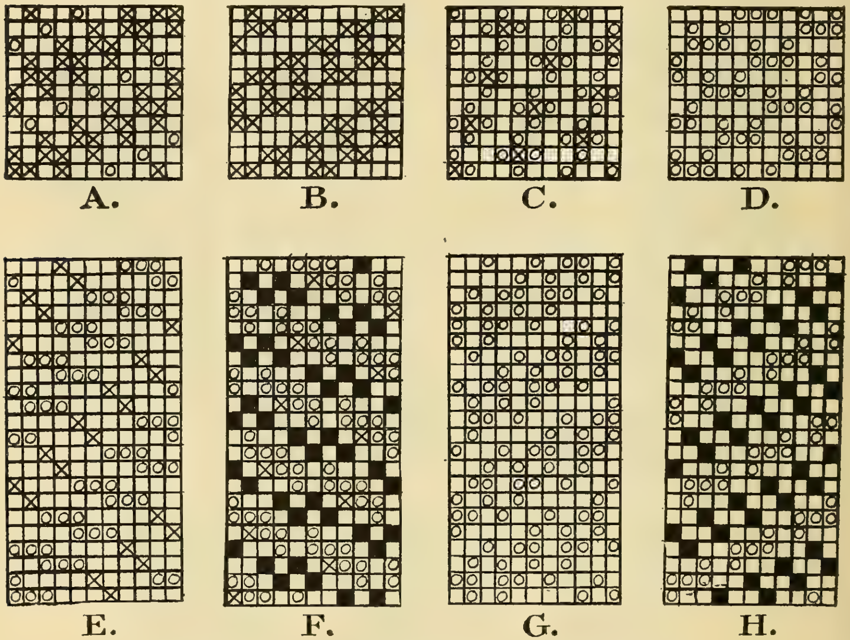


FIG. 107.—EXAMPLES IN ELEVEN-SHAFT WEAVES.

production in ordinary, as well as in specialized groups of crossings. The examples given, therefore, acquired on elementary twill bases, will be supplemented by the several series of weaves producible on multiples of threads requiring from six to sixteen-shaft mountings.

Primarily, it has been shown that on 4, 5, 6, and 7, etc., threads or heddles, twills, mats and sateens are obtainable of a similar structure in each group of shafts, but differing in the

dimensions of the floats of warp and weft yarns in the two former, and in the latter in the scale of the warp or weft intersections. Adopting increased closeness of setting as the floats increase in size, gives a finer and better grade of cloth, while adopting the same or a corresponding setting, and using thicker yarn counts, gives a coarser and heavier make of cloth, with the dimensions of the interlacings or the "effects" broader in character. In the case of crossings on sateen bases of an identical formation (*see* twilled mats on 8, 10, and 13 shafts, Fig. 101) the intersection points are less frequent with the enlargement of the weave plan.

The significance and value of these factors come out in cloth manufacture. Assuming, for example, that the effects of a selected plan are satisfactory in a fabric of a determined setting, and that (*a*) a finer cloth is required of a similar textural character, but in a weave of a larger number of threads, then in using the same yarns the setting would be proportionately increased ; (*b*) that it is required to develop more pronounced textural features in the selected weave, then the basis or number of threads on which the weave is constructed would be enlarged ; and (*c*) that a better definition is desirable in either the warp or weft details, then an alteration may be made in the weave, changing the shaft mounting, and also the warp and weft threads per inch, increasing or decreasing these in a fixed and relative ratio according to which class of detail, warp or weft, it is intended to emphasize.

166. *Six, Seven, and Eight-Shaft Weaves* (Figs. 102, 103 and 104).—Weaves occupying a small number of shafts have two distinctive applications : (1) in cloth building, and (2) as units in figured pattern development. The second application will be illustrated in treating of compound designs and of the principles of figuring. Cloth building, as due to the weave plan, not necessarily derived from ordinary twills, but from more original weave units, is exemplified in the groups of weaves seen in Figs. 102 to 112. A consideration of these suggests the degree to which the geometric planning of the

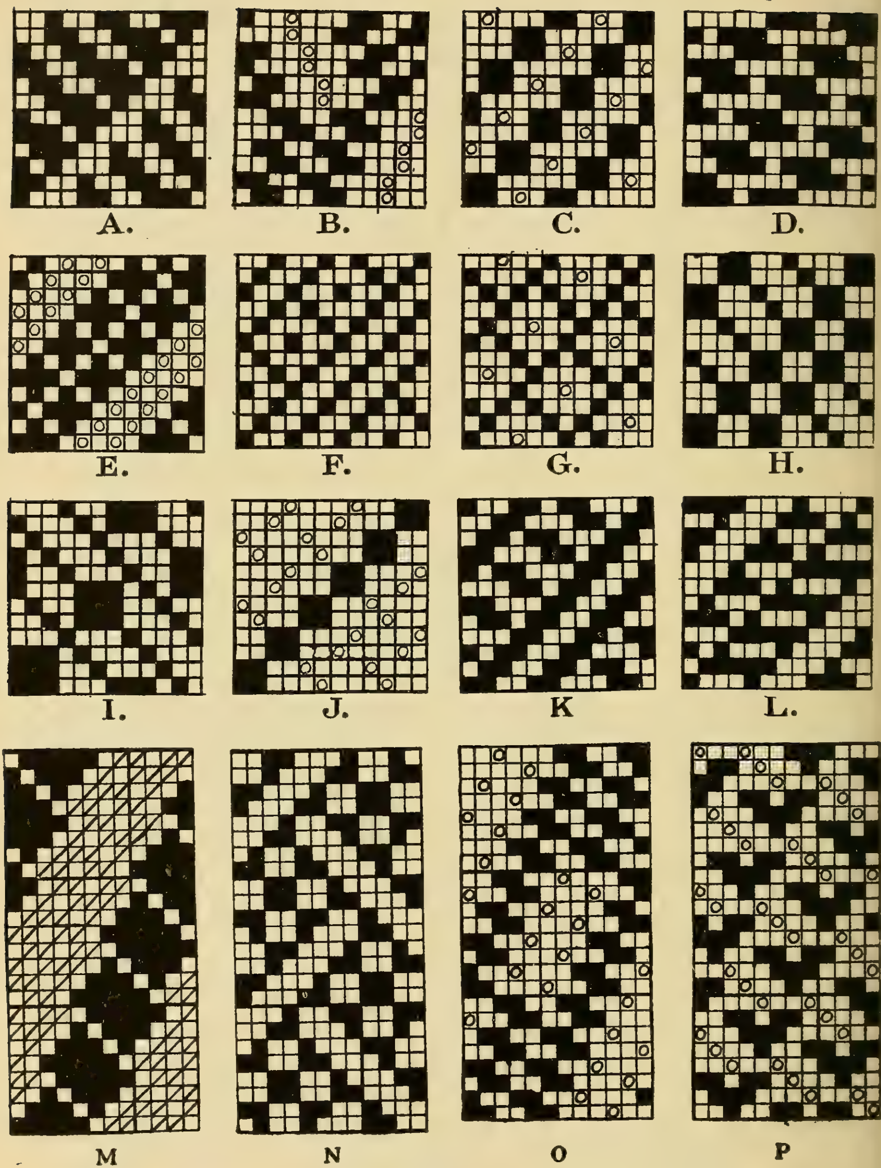


FIG. 108, PLANS A TO P.—EXAMPLES IN TWELVE-SHAFT WEAVES.

intersections may be made to give, in each group of threads, types of effect strongly differing from each other in form and arrangement, and also, in the build and style of fabric they produce. Though, for example, the 6-shaft weaves in Fig. 102 are restricted to this small number of threads, they include the detail twills A, D, and G; the angled twill F; the transposed

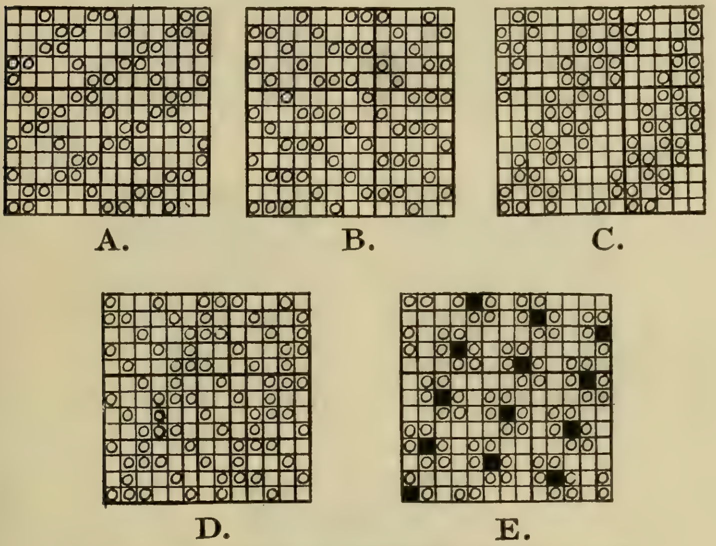
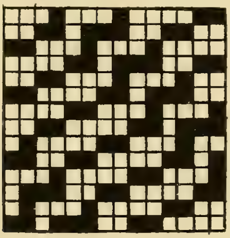


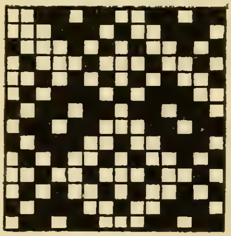
FIG. 109.—EXAMPLES IN THIRTEEN-SHAFT WEAVES.

make H; the cut check C; the broken mats E, I, L, and M; the waved $\frac{3}{3}$ twill cutting in the picks K; and the whipcord plans N and O. Changing the shaft mounting to 7 heddles (Fig. 103) renders it possible to obtain other classes of effect, especially twills of a fine warp or weft character, and with the angle of the twill varied. Plans B, D, E, and F, each repeating on 14 picks, are seen to be distinct from each other in the warp lines, and in the detail interlacings; with plan C yielding a sort of twilled mat, and G composed of sections of $\frac{2}{2}$ twill forming small diagonal lines. Increasing the shaft multiple to 8 (Fig. 104) enables other intersection bases to be devised of quite another description to those arranged on

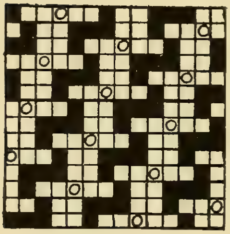
6 and 7 shafts. The makes typified include reversed check effects, A and H and J and O; varied twills as in the mat and warp lines details in plan B; the warp line and diamond



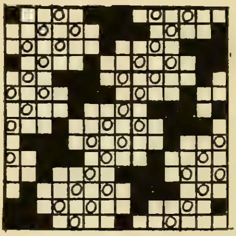
A.



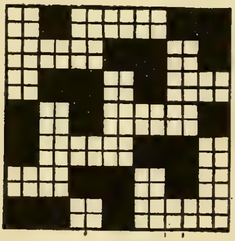
B.



C.



D.



E.

FIG. 110.—EXAMPLES IN FOURTEEN-SHAFT WEAVES.

spotted plan D; the fine warp twills L and N; Mayo effects E, F, K, and P; and the transposed and spotted types G and I. More elongated twilled patterns than those included in this series, and formed on 16, 24, and a larger number of picks, have already been dealt with in Paragraph 151.

167. *Weaves on Nine, Ten, and Eleven Shafts* (Figs. 105, 106,

107).—An analysis of these shows how the intersection types become increasingly diversified in detail in the larger systems

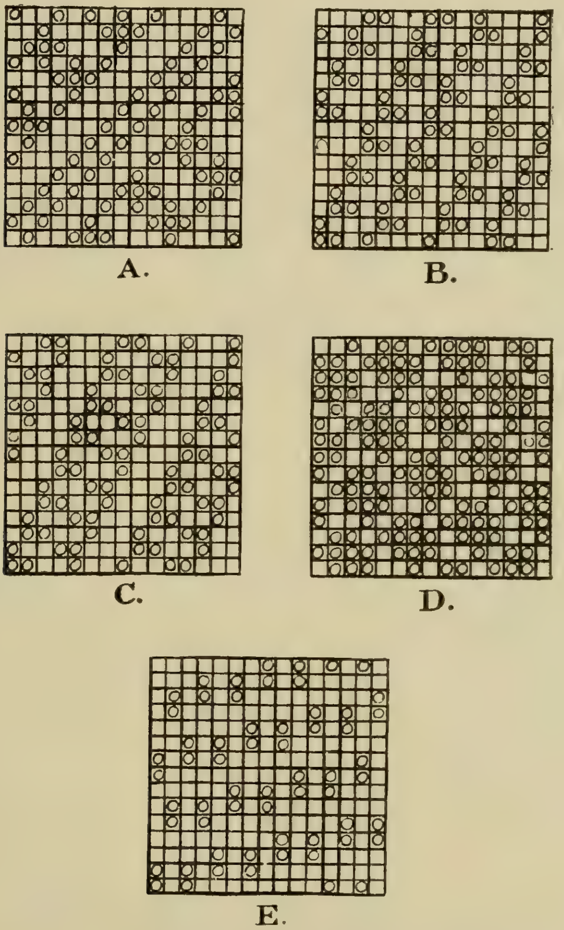


FIG. 111.—EXAMPLES IN FIFTEEN-SHAFT WEAVES.

of shaft-mounting. The examples A, B, and C in Fig. 105, resemble weaves producible on 7 shafts, but those at E, F, and G comprise quite another class of weave, E being a spotted twill, F a fancy twill with a preponderance of weft, and G a clear warp twill in a line with a weft twill in small spottings. The

10-shaft base, like the 8, enables weaves of a regular, and also of a fancy character to be constructed ; thus A, B, and C, (Fig. 106) are of the twilled order, plan A being a fine warp effect, B a crêpe, and C consisting of a line of twilled mat crossed with warp details. Weaves D and E are transposed effects developed in warp and weft respectively. Plan F is arranged on a double 5-end sateen base. Adding to the number of picks in the weaves gives the type in H to N, namely, a 10-shaft spotted plan H, a weft cord twill I, and the small diagonal patterns J, K, L, M, and N. The 11-shaft makes (Fig. 107) are still more diversified in textural detail, A and B being oblique twills, C and D crêpes, E a weft cord and warp-face twill compound, and F, G, and H " effect " twills due to constructing a small " motive " and grouping the repetitions of it on an extended sateen base.

168. *Weaves on Twelve, Thirteen and Fourteen Shafts* (Figs. 108, 109 and 110).—The principal types on 12-shafts, as illustrated in Fig. 108, include—

(1) Shaded Twill, A.
(2) Weft-striped Effect, B.
(3) Hopsack Twills, C and H.
(4) Weft-effect Twills, E, D and L.
(5) Warp-twill and Diamond Effects, F and G.
(6) Mat-spotted Type, with warp twill ground, I.
(7) Mat and " Swansdown " Twill, J.
(8) Pattern composed of ${}_{2}{}^{2}$ twill to the right and ${}_{2}{}^{2}$ twill to the left, K.
(9) Weft-face Twill, M.
(10) Transposed Plan, with mat ground, N.
(11) Compound Twills, O and P.

On 13-shafts (Fig. 109) similar plans are formable as on 11, and also the types shown at A to E (Fig. 108) as well as others of a definite diagonal character by extending the picks. The weaves illustrated are distinct in formation, A being of a matted structure, B a weft cord and fine warp twill, C a clear warp twill, D a modification of B, and E a hopsack twill. The examples on 14 shafts (Fig. 110) include plan A composed of

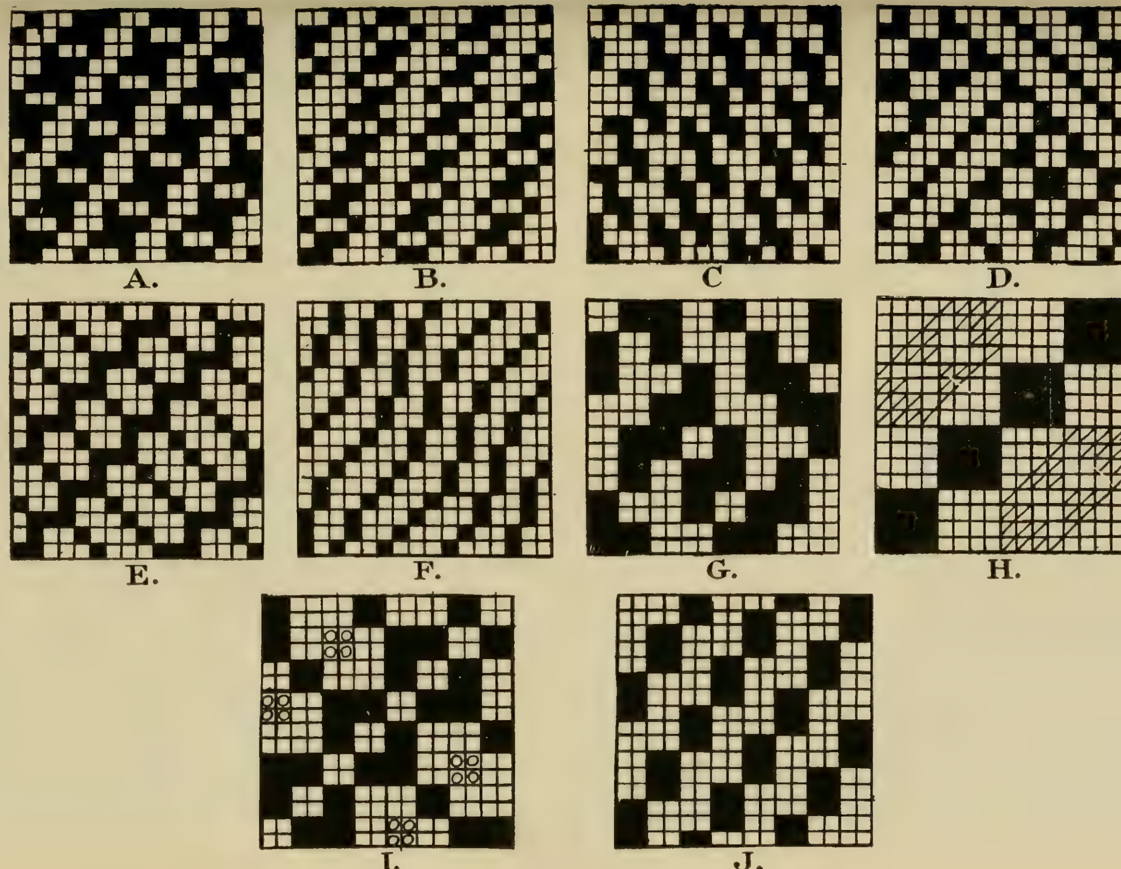


FIG. 112.—EXAMPLES IN SIXTEEN-SHAFT WEAVES.

double plain and step twill, B constructed on a diamond base, C on a sateen base, and D on a duplicated 7-shaft sateen base. Plan E is due to the extension of the threads and picks of plan A (Fig. 103).

169. *Weaves on Fifteen and Sixteen Shafts* (Figs. 111 and 112).—Several 15-shaft weave units are given in Fig. 111. They are illustrative of compound twilling, plan A; of warp-face twilling, plans B and C; of weft-face twilling, plan D; and of corkscrew twilling, plan E.

A number of the 8-shaft weaves are subject to enlargement by doubling the threads and picks, producing them on 16-shafts for giving open pattern elements as in plan I (Fig. 112), an enlargement of plan P (Fig. 104). Diagonal patterns are also obtained on 32 or more picks, and by the designing practices explained in Paragraph 134. The 16-shaft plans reproduced in Fig. 112 comprise—

Plan A = A Step Twill.
,, B = A Whipcord Twill.
,, C = A Fancy Warp Twill.
,, D = A Transposed Effect with mat features.
,, E = A Diagonal Twill.
,, F = A Waved Twill.
,, G = An Open-structure of Transposed Pattern.
,, H = A Compound Mat Check.
Plans I and J = Doubled 8-shaft Weaves.

It should be observed that the various weave structures included in these examples are not only employed as illustrated, in which the blanks represent warp interlacings, but also with the marks taken as warp and the blanks as weft effects. With either the warp or the weft features predominating in the plans, the weaves are suitable for reversing, and also for combination with each other in producing striped, checked, and other varieties of design.

CHAPTER VI

DRAFTED PATTERNS: STRIPES

170. *Angled-Twill Stripes.*—The term drafting is applied to the method of entering the warp threads into the healds of the shafts or heddles. It results in the transmutation, according to plan, of the grouping of the thread units of which a design is composed. The number of shafts required in the production of a design, as prepared on point paper, is that of the multiple of the distinct types of thread it contains.

It has been shown that, in the examples of crossings derived from a simple intersection base, by re-arranging the threads of a given weave unit, various textural plans are producible. The varieties of design thus formed have not, however, been either of a striped or of a checked character. In one sense the waved or serpentine patterns are a species of stripe, as the dice patterns are a form of checking; but the true striped style consists of clear, parallel lines of effect, and the correct checked style, of lines of effect intersecting each other at right angles.

Waved compound styles differ from angled patterns in the order in which the twilling is reversed, that is, at the juncture in the plan where the line direction of the twill is changed; while in the herringbone or angled stripe, the warp

and weft twilled lines cut or oppose each other at the reversing point in the design. The system of drafting followed results in such differences in these two elementary forms of stripe.

What are known as the "angled," "sateen," and other healding practices, are applied to the several classes of simple weaves in the origination of striped, checked, and all-over schemes of pattern. To illustrate this branch of pattern work, reference will be made, in the first place, to the tweed costume specimens in Fig. 113, and to the worsted textures in Fig. 114. The tweed examples are woven in the $\frac{2}{2}$ twill, and the worsted examples in the $\frac{3}{3}$ twill, and in the healding drafts outlined in Figs. 113A′ to D′, and in Figs. 114E′ to J′. The numerals in the drafts indicate the order of the shafts, and the marks show the method of distributing the threads in "drawing-in" the warp on to the shafts 1, 2, 3, and 4, Fig. 113, and on to the shafts 1, 2, 3, 4, 5, and 6 in Fig. 114. The striped patterns obtained by the combination of the Plans $113A^2$ and 114D′ with the healding drafts, are described below—

Fig. 113, Specimens A, B, C, and D

Specimen A—$\frac{2}{2}$ twill, drafted "straight," as at Fig. 113 A′.
,, B—Angled stripe, composed of lines of 8, 4, and 2 threads, twilled to the right and to the left alternately, and drafted as at Fig. 113, B′.
,, C—Stripe composed of lines of twill cutting in two's and moving to the right and to the left, of lines of twill to the right, and of small lines of mat—Draft Fig. 113, C′.
,, D—Stripe composed of angled twill, mat, and warp rib—Draft Fig. 113, D′.

Fig. 114, Specimens E, F, G, H, I, J

Specimen E—$\frac{3}{3}$ twill angled 6-and-6—Draft Fig. 114, E′.
,, F—$\frac{3}{3}$,, ,, 96-and-96— ,, ,, 114 F′.
,, G—Composed of angled effects formed of 12 and 12 lines for 96 threads, and of 6 and 6 lines for 96 threads—Draft Fig. 114, G′.
,, H—Composed of stripes of twill to the right and of stripes of twill cutting in three's—Draft Fig. 114, H′.
,, I—Composed of broad stripes of twill, and of twill cutting in three's, and of lines of mat—Draft Fig. 114, I′.
,, J—Composed of various sizes of stripes in angled twill, and of lines of twill cutting in two's—Draft Fig. 114, J′.

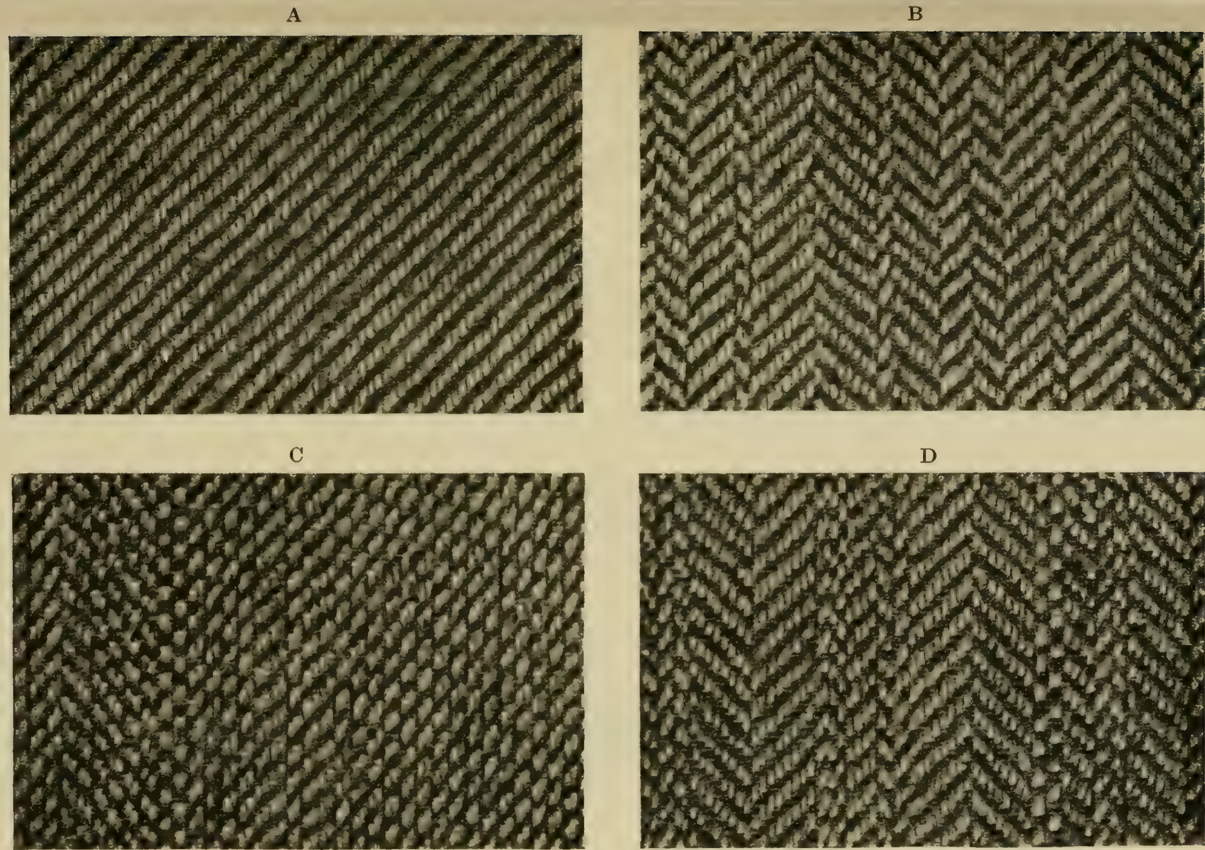


FIG. 113.—DRAFTED PATTERNS—TWEED COSTUME CLOTHS.

FIG. 113 A²

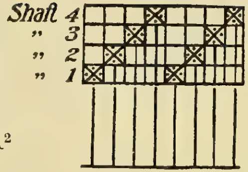


FIG. 113 A′

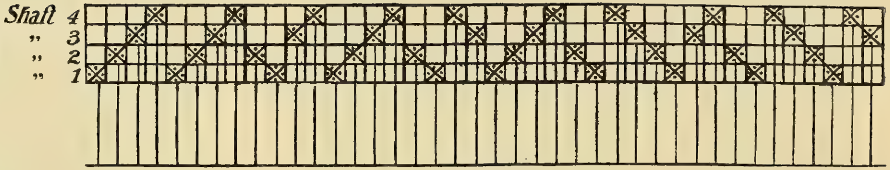


FIG. 113 B′

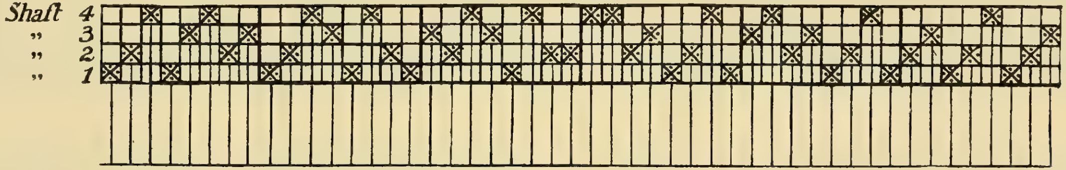


FIG. 113 C′

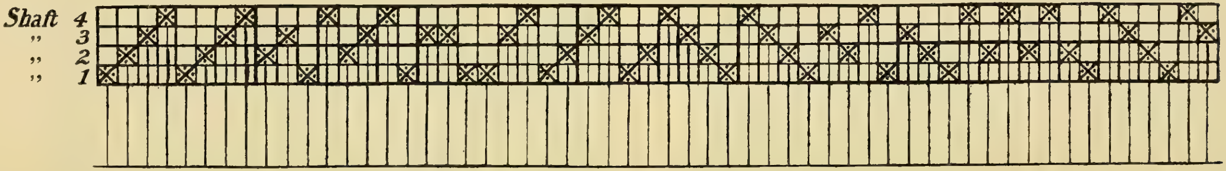


FIG. 113 D′

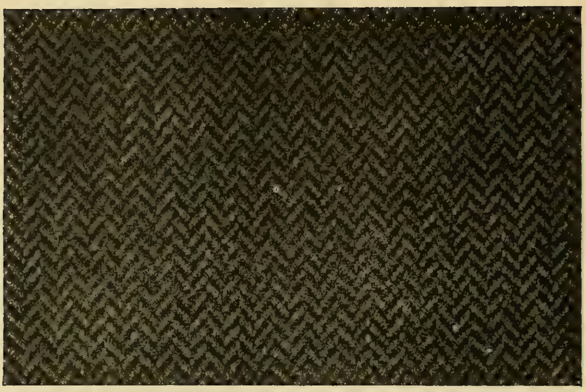
HEALDING DRAFTS FOR SPECIMENS A TO D, FIG. 113.

It follows that, as 4-end and 6-end weaves are here employed in the healding drafts, Fig. 113A′ to D′, the $\frac{1}{3}$ twill might be used, and in the healding drafts, Fig. 114E′ to J′, the $\frac{1}{2}\frac{2}{1}$ twill might be applied. Similar healding drafts are formable on other multiples of shafts, such as 5, 7, 8, and 9, rendering the standard twills for such shaft mountings usable. In addition, the plans acquired by re-arranging the threads of a simple weave unit, illustrated in Figs. 74 to 78 inclusive, are suitable for combination with each other, with the basic weave as the looming plan in the weaving of the patterns. The method of combination, and the type of weave derivative applied, are, in all examples of this description, subservient to the style of design desired, and the class of fabric to be manufactured.

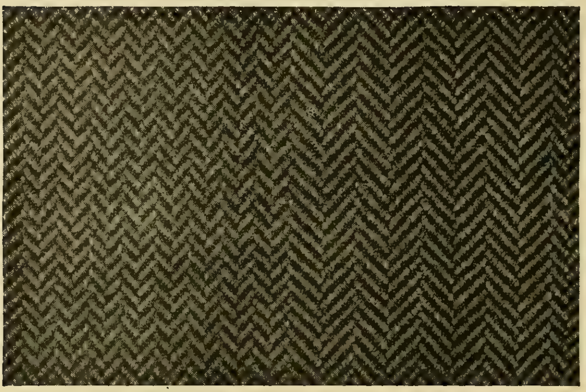
171. *Designs on a Small Number of Shedding Units.*—With the restricted shedding capacity in tappet and dobbie looms, systems of healding are of paramount value and importance. They enable styles of a composite textural character to be developed; first, in weave plans as exemplified in the derivatives of the common twills; second, in compound weave designs such as stripes and checks; and third, in designs arranged on a geometric base. The principles of healding are fundamental to the varieties of pattern types producible in a given plan of a limited number of threads, having different intersecting points. For example, in the 4-shaft and 6-shaft crossings (Figs. 113A^2 and 114D′) there are in these two sorts of weave four and six distinct thread units. The transposition and re-arrangement of the threads by the healding draft, results in the distinct styles of striping observed in the woven specimens. When limited to two or three threads, many descriptions of pattern are also formable.

Designing, by the re-grouping of such threads, has some elements in common with the mathematical infinitude in the origination of the magic square in the use of the root of four, from which it is possible to obtain some 600 billion modifications, all included in the summation of 1891, and yet each

E



G



I

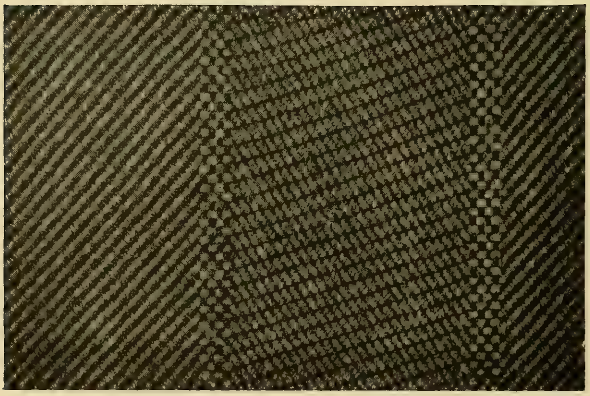
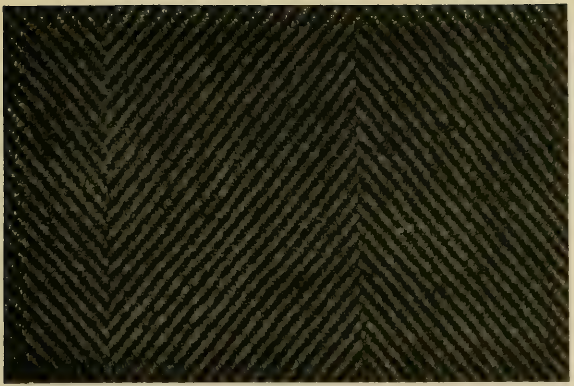
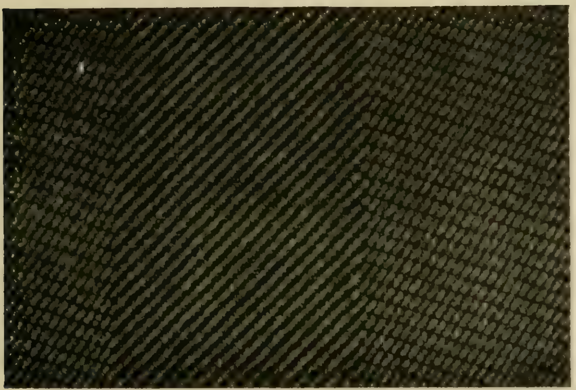


FIG. 114.—DRAFTED PATTERNS—WORSTED COSTUME CLOTHS.

F



H



J

Fig. 114.—Drafted Patterns—Worsted Costume Cloths.

PLAN

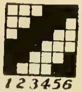


FIG. 114 D′

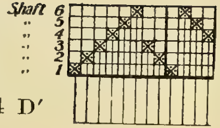


FIG. 114 E′

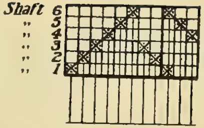


FIG. 114 F′

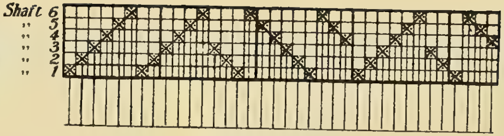


FIG. 114 G′

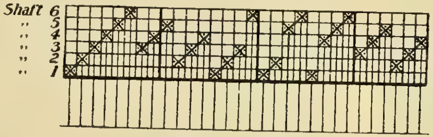


FIG. 114 H′

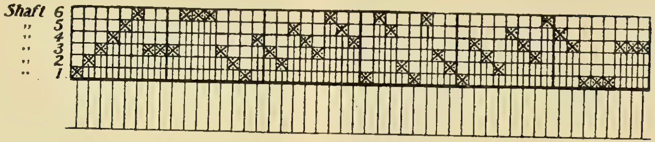


FIG. 114 I′

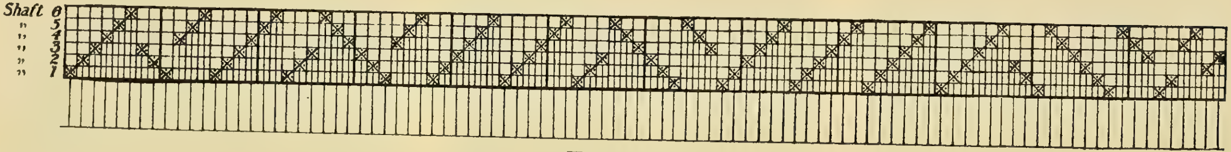


FIG. 114 J′

HEALDING DRAFTS FOR SPECIMENS E TO J, FIG. 114.

square made up of sections in which the order of the numerals differ. Weave planning, by the re-arrangement of the threads or picks, in the multitude of changes of which it is productive, bears some resemblance to the process of magic square compilation; or, it may more aptly be compared to the diversity of harmonies possible in the art of music from a given octave of notes. Thus, with ingenuity in the formation of the interlacings of the thread units, and in their methods of grouping, patternwork may be diversified to an illimitable degree.

172. *Effects on Two Shafts.*—When confined to the lowest number of shedding units, that is to two intersecting threads, there is a considerable compass provided in the formation of striped and checked patterns, as seen in the designs sketched in Figs. 115 to 120. The striped example (Fig. 115) contains three widths of line, developed in warp cord, ordinary mat, and elongated hopsack. Obviously, by varying the dimensions of these lines, and also by changing the type of the cord plan, the mats would also be modified; and, with these alterations, other forms of striping would be producible. In addition, distinctive stripings weavable on two shafts, because composed of two threads, Nos. 1 and 2 in the examples, may be acquired by using either the transverse sections, A or B, in Figs. 117 to 120; for when these are separated from the designs of which they form a part, they become striped styles consisting of—

Fig. 117, Section A = A stripe of 3 threads of warp cord and of 10 threads of mat.

,, B = A stripe of 3 threads of plain and of 10 threads weft cord.

Fig. 118, ,, A = A stripe consisting of lines of 5 threads of plain, 2 threads of weft cord, 2 of plain, and of 2 of weft cord.

,, B = A stripe consisting of lines of 5 threads of warp cord and plain, 2 threads of mat and weft cord, 2 threads of warp cord and plain, and of 2 threads of mat and weft cord.

Fig. 119 Section A = A stripe consisting of lines of 4 threads of warp cord, 7 threads of mat, and of 4 threads of warp cord.

,, B = A stripe consisting of lines of 4 threads of plain 7 threads of weft cord, and of 4 threads of plain.

Fig. 120 ,, A = A stripe consisting of 5 threads of plain and warp cord, 2 threads of weft cord, and mat, 5 threads of plain and warp cord, and of 10 threads of weft cord and mat.

,, B = A stripe consisting of 5 threads of warp cord, 2 threads of elongated mat, 5 threads of warp cord, and of 10 threads of mat.

173. *Checked Patterns on Two Heddles.*—As stated, each of the examples, in Figs. 115 to 120, is composed of the 2 threads numbered 1 and 2, which are necessarily the reverse of each other in intersections. In making such plans, the formation of the thread unit is the first factor, and the grouping of the 2-thread units, in an ordered stripe or checked form, the second factor. The checkings become interesting in textural features and in style with the varied character of the unit threads combined. The use of threads, simple in order of interlacing, are seen to give (Figs. 116 and 117) two kinds of mosaic checking. Thus the effects in ■'s and in ⊡'s (Fig. 116) correspond in size, but those in Fig. 117 consist of squares of 10 threads and picks, and of 3 threads and picks, and of oblong sections of 3 threads of warp cord and 3 picks of weft cord. In Fig. 118, another plan of arrangement has been applied, namely, lines of effect, in plain and weft cord of 5 and 2 threads, intersecting with similar lines in the weft. With a further diversification in the interlacings in the thread units, and also in the practice of their combination, the designs in Fig. 119 and 120 are obtained. In Fig. 119 the intersections in thread No. 1 consist of—

$$\frac{1\quad 1\quad 3\quad 1\quad 1\quad 1\quad 1\quad 2\quad 2\quad 1\quad 1}{1\quad 2\quad 2\quad 1\quad 1\quad 1\quad 1\quad 3\quad 1\quad 1\quad 1}\quad \begin{array}{l} = \text{Warp intersections} \\ = \text{Weft} \qquad ,, \end{array}$$

and in thread No. 2 of—

$$\frac{1\quad 2\quad 2\quad 1\quad 1\quad 1\quad 1\quad 3\quad 1\quad 1\quad 1}{1\quad 1\quad 3\quad 1\quad 1\quad 1\quad 1\quad 2\quad 2\quad 1\quad 1}\quad \begin{array}{l} = \text{Warp intersections} \\ = \text{Weft} \qquad ,, \end{array}$$

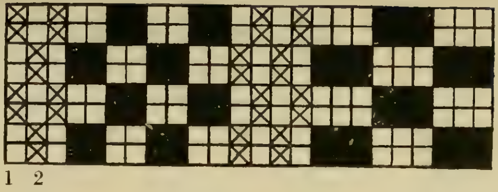


FIG. 115

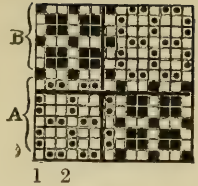


FIG. 116

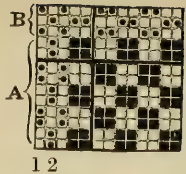


FIG. 117

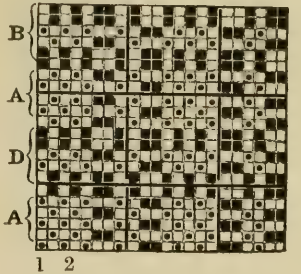


FIG. 118

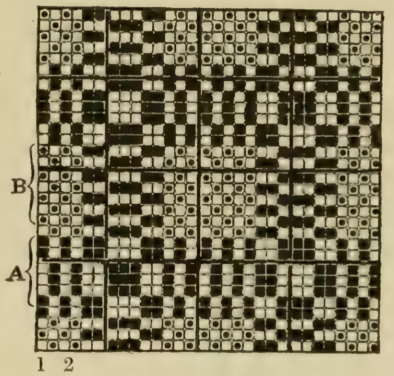


FIG. 119

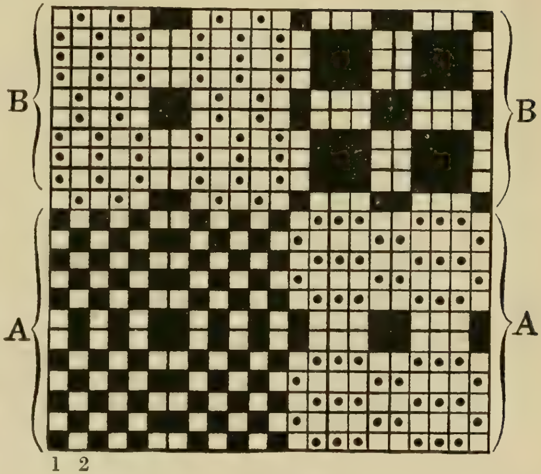


FIG. 120

STRIPED AND CHECKED PATTERNS WEAVABLE ON TWO SHAFTS.

while in Fig. 120, the intersections in thread No. 1 consist of—

1	1	2	1	1	1	2	1	=	Warp intersections
1	1	1	1	1	1	3	3	=	Weft ,,

and in No. 2 of—

1	1	1	1	1	1	3	3	=	Warp intersections
1	1	2	1	1	1	2	1	=	Weft ,,

Obviously, when limited to 2 thread units, many types of pattern may be produced in piece-dyed and coloured goods. The designs are also adapted for style origination in both warp and weft colouring. For example, certain of the sections marked in ■'s, may, in the development of the plans, be woven in a thicker yarn, or in a different colour of yarn from certain of the sections in ⊡'s. Each method of looming has the result of enforcing the details in the weave scheme. Should this be essential, the order of warping, or of both warping and wefting, may be made to coincide with the form of the design construction, in which instance Figs. 119 and 120 would be suitable for colour treatment on the following lines—

Fig. 119.—Order of Warping

1	thread	of tint	or shade	*a*	} for 4 threads.
1	,,	,,	,,	*b*	
2	,,	,,	,,	*a*	
3	,,	,,	,,	*b*	
2	,,	,,	,,	*a*	
1	,,	,,	,,	*b*	} for 8 threads.
1	,,	,,	,,	*a*	
2	,,	,,	,,	*b*	
3	,,	,,	,,	*a*	
2	,,	,,	,,	*b*	
1	,,	,,	,,	*a*	} for 4 threads.
1	,,	,,	,,	*b*	

Orders of Wefting

I. A light tint or shade.
II. A medium tint or shade.
III. Same order as warping.

FIG. 120.—ORDER OF WARPING

1	thread of tint or shade			*a*	for 5 threads.
1	,,	,,	,,	*b*	
2	,,	,,	,,	*a*	
1	,,	,,	,,	*b*	for 5 threads.
1	,,	,,	,,	*a*	
10	,,	,,	,,	*b*	

ORDERS OF WEFTING

I. A light tint or shade.
II. A medium tint or shade.
III. Same order as warping.

The order of colouring in Fig. 119 causes alternate sections in the mat to be developed in the tints *a* and *b*. Other methods of colouring weave patterns of this description consist in producing each effect in a special shade of yarn, thus—

FIG. 118.

5	threads of tint or shade			*a*
2	,,	,,	,,	*b*
2	,,	,,	,,	*a*
2	,,	,,	,,	*b*

FIG. 119.

4	threads of tint or shade			*a*
7	,,	,,	,,	*b*
8	,,	,,	,,	*a*
7	,,	,,	,,	*b*
4	,,	,,	,,	*a*

FIG. 120.

12	threads of a tint or shade			*a*.
10	,,	,,	,,	*b*.

174. *Designing on Three Shafts.*—The employment of three heddles or shafts has the advantage over two heddles, inasmuch as it allows of the production of twilled as well of cord and mat effects. The varieties of plan units obtainable from the prunelle, by the re-arrangement and extension of the weave base, are given under Fig. 71, but other interlacing elements are formable with three threads, which may be applied in developing designs on this number of heddles, such as the striped patterns

in Figs. 121 to 127. The first is composed of the prunelle twill waved in the weft, section A, and of the same twill reversed in section B, hence a stripe consisting of these two

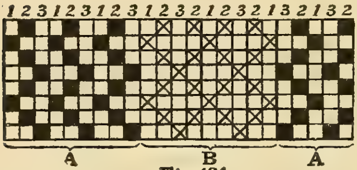


Fig. 121

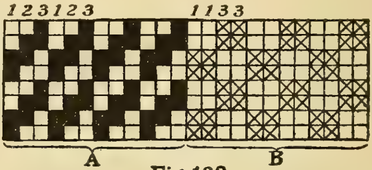


Fig. 122

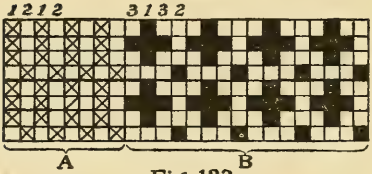


Fig. 123

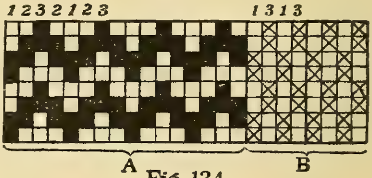


Fig. 124

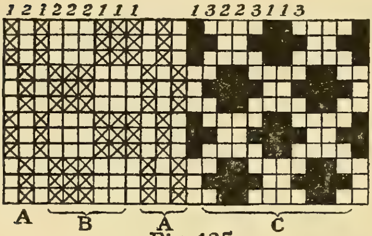


Fig. 125

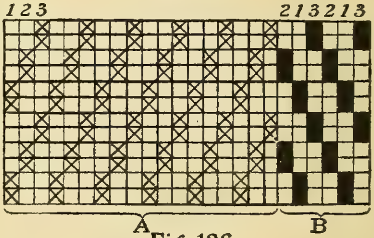


Fig. 126

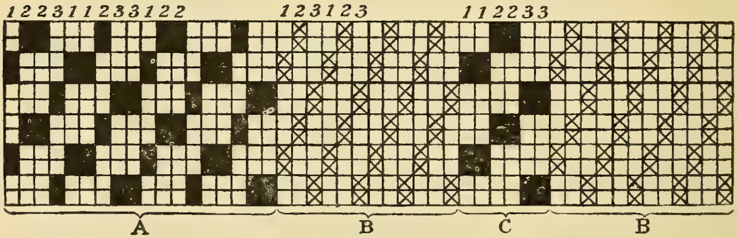


Fig. 127

STRIPED PATTERNS WEAVABLE ON THREE SHAFTS.

lines of effect. Fig. 122 is composed of three ends of the $\frac{2}{2}$ twill cutting every third thread, and of mat; while Fig. 123 is a combination of an irregular warp cord and of a bird's-eye spot. Selecting three alternate threads of the $\frac{2}{2}$ twill gives

an effect on three shafts, and using two of these threads (1 and 3) gives a mat; hence the combination of the two effects, as in A and B in Fig. 124, yields a striped design. For producing more open effects on three shafts, $\frac{3}{3}$ mat and cord are usable, with the small weave effect, seen at C in Fig. 125. By extending the prunelle in the picks, and running it to the right and to the left (section A and B, Fig. 126) fine angled-twill patterns result. Doubling the twill in both the threads and picks, and combining the resultant effect with a weave two picks in a shed, and in the form seen at A, B, and C (Fig. 127) a striped pattern is acquired composed of a line, A, of step twill; a line, B, of upright twill; and a line, C, of mat twill.

The numerals at the top of each of the plans show the healding order, which, it will be observed in all the examples, contains three threads workable on three shafts, and from such numerals the method of design originated may be ascertained in each instance.

Elementary forms of striping have been selected, but it will be clear that these may be elaborated either in the character of the line, or in the grouping of lines of different sizes of each of the effects comprised—principles of work which are common to all drafted designs of this category.

175. *Repp Patterns.*—These should be distinguished from the cord variety of design described in Paragraph 153. They are formed—

(1) By combining two or more warp face weaves, e.g. A' and A^3 and A^2 and A^4 (Fig. 70).

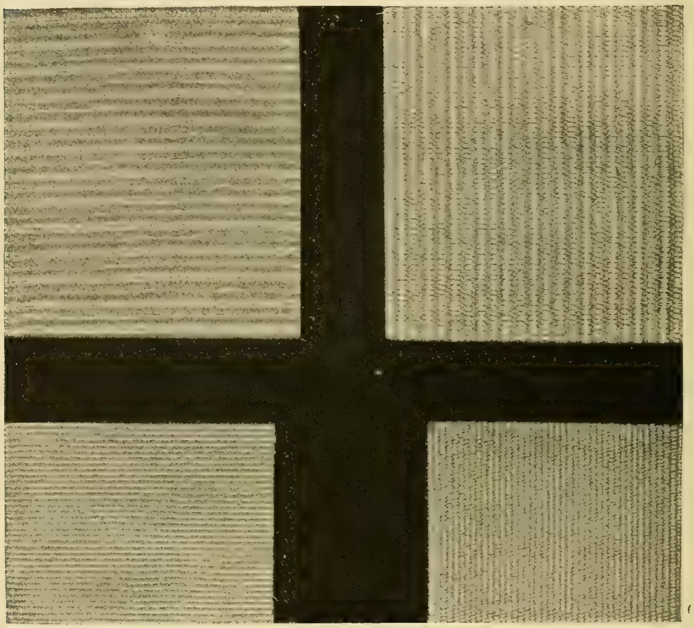
(2) By combining weft face weaves, e.g. Q and R (Fig. 102) and 2-and-2 and 4-and-4 ribbed weaves, etc.

(3) By combining two or more warp-face and weft-face weaves, such as A^2 and A^7, Fig. 70; and by combining two types of warp ribs with similar ribbed weaves transposed.

Specimens A and B (Fig. 128) are woven respectively in the $\frac{2}{1}\frac{4}{1}$ warp and weft repp makes, and specimens C and D in the $\frac{2}{2}$ warp and weft cords. Combining, on the first principle, the effects in A and C, would develop lines in the

warp concealing the shots of weft, and combining, on the second principle, the effects in B and D, would develop lines in the weft concealing the threads of warp. This implies that the warp yarn would be the chief ingredient of the first style of texture, and the weft yarn the chief ingredient of the second

A B



C D

FIG. 128.—WARP AND WEFT CORD TEXTURES.

style. Varieties of striping in either the *warp* or *weft* face plans are obtainable by changing the intersecting order of the weave units selected.

When both warp and weft effects are employed, as in the third scheme of combination, rib plans may be of a like or of a different formation. Patterns may, for example, be produced in lines of A and B or C and D, or of A and D (Fig. 128); and in $\frac{4}{4}$ warp rib with plan R (Fig. 102). The three methods of

combination are diversified in a number of ways as in the use of two kinds of warp rib (section B, Fig. 129) in arrangement with a warp-faced twill stripe A, or by using one or several ribs composed of different interlacings with common twills and other crossings. In the specimen, $\frac{2}{2}$ and $\frac{\ 4\ }{2\ \ 2}$ warp ribs are combined in stripe B, giving the transverse features composed of fine and open repps. For producing such designs, the number of heddles for the cord details need not exceed two,

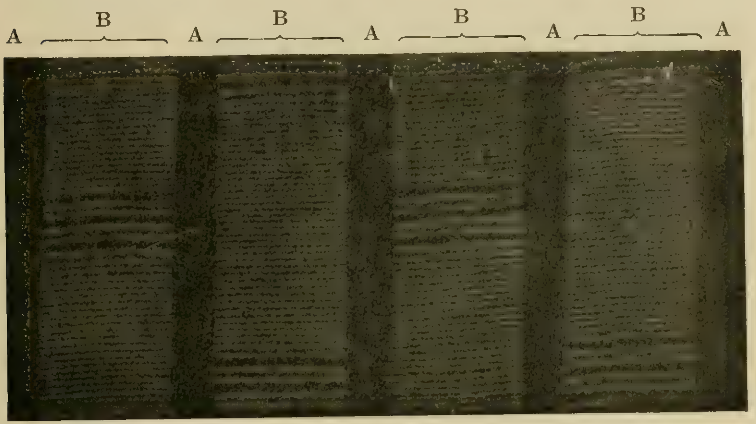


FIG. 129.—WARP CORD AND FINE-TWILL STRIPE.

but the number for the twilled sections should coincide with the number of threads in the weave applied.

176. *Twilled-Repp and Mat Stripes.*—The $\frac{2}{2}$ twill is ordinarily combined with the 2-and-2 and 4-and-4 cords, and the $\frac{3}{3}$ twill with the $\frac{3}{3}$ and $\frac{6}{6}$ cords, or with cord plans containing a corresponding number of threads or picks as the twilled weaves. In addition, simple twills are combined with mats or hopsacks, and the patterns are made in cotton, worsted, silk, and linen goods, and comprise stripings in almost any kind of line assortment and grouping as—

(*a*) Types of pattern in twill, mat, and cord, of equal widths, and in minute, medium, and broad lines.

(*b*) Types of pattern in twill, mat, and cord, of two or more lines of effect of different widths and interchanging in position.

(*c*) Types of pattern in three or four widths of line.

The factors, which determine the line dimensions and the weave structure applied, are the setting of the cloth and the style producible. Moreover, cord plans, twills, and angled twills, as also the derivatives of twilled makes, are formed into pattern types with rib and mat weave units, and become draftable on to the shaft mounting adapted to the twill or basic weave in the patterns.

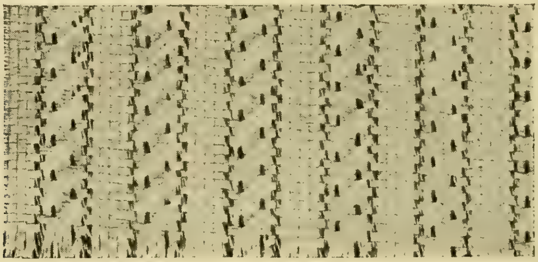


Fig. 130.—Twill and Mat Pattern.

Should the cloths be required to be made firmer in construction than those obtained in the standard crossings, modified twills and mats are combined, and these increase the shafts usable. The example in Fig. 130 is composed of plans A and E (Fig. 102) and is illustrative of this, the twilled weave consisting of a 6-thread, and the mat of a 4-thread unit. Other modified weaves of this kind, made on 8 instead of 6 shafts, are B and C (Fig. 104) which might be utilized with J, O, and Q. In the lighter makes of fabric, and with the view of making a firm structure, plain interlacing intersections may be run underneath the floating threads or picks of the mat or cord, constituting the weave effects on the surface.

177. *Matted Stripes.*—Elongated mats which have been shown to be derived from warp and weft ribs, are employed

for stripes, on similar principles to the ribbed weaves alluded to. Irregular mats—i.e. mats containing an odd number of threads and picks—may be readily converted into striped and checked designs weavable on 2 or 4 heddles, and those chiefly used are formed on 5, 7, and 9 threads. The modified type of mat, E and Q (Figs. 102 and 104) and also C and J in the same series, are combinable with ordinary mats on six and eight shafts.

Another basis of work comprises the use of elongated mats, as shown in Fig. 131, where the effects in the respective stripes may be increasingly defined by extending the mat base. Here the 4-end mat has been enlarged in the picks in section A, and in the threads in section B; hence by similarly enlarging six on eight shaft mats, and combining their derivatives, the striped lines, which they are arranged to compose, strongly contrast with each other in the fabric. It is essential that the two makes should be correctly joined together by starting and finishing one of the mats with single threads, so that the weaves in the stripings fit evenly with each other, as in A and B in the example. This rule is also observed when the plans are made into checked styles.

178. *Multi-form Character of Derivative-Weave Stripes.*—The economy in shaft mounting, due to constructing striped patterns on a standard twill or crossing, is now evident. The extent to which the pattern types may be diversified has also been suggested. While, therefore, the numerous classes of striped designs, producible in each of the ordinary twill bases, need not be illustrated, it is important to show the application of this practice, in pattern design, to other and larger weave units than those treated of. For this purpose, designs consisting of three and four weave units, and devised on the 8, 9, and 13 shaft twilled bases, are typified in Figs. 132, 133, 134, and 135. Each of these patterns is formed of weave effects derived from section A, so that it is a question of using this section as the looming plan, and of healding the warp on the shafts in the order of the numerals on the upper line of the

designs. Examining these examples shows that they comprise the following lines of effect—

Fig. 132. A striped design on 96 threads—consisting of lines A, in $\frac{4}{4}$ twill ; B in stepped cork screw ; and C in corkscrew or warp-cord twill—draftable on to 8 shafts.

Fig. 133. A striped design on 63 ends—consisting of lines of waved-twill A and C, and of lines of matted-twill B—draftable on to 9 shafts.

Fig. 134. A striped design on 96 ends—consisting of five lines of effect, namely, stripe A $\frac{5}{4}$ twill to the right ; B in the same twill to the left ; C in oblique corkscrew ; D in step twill ; and E in interrupted twill—draftable on to 9 shafts.

Fig. 135. A striped design of 78 threads—consisting of four lines of effect, namely, a broad line A in fine twill ; lines B and D in upright twill ; and C in upright twill angled to form a pointed feature in the fabric—draftable on to 13 shafts.

The technical characteristics observed in these examples are : (1) the diversity of striped pattern acquired both as to the number of threads forming a repeat, and as to the dimensions of the lines A, B, C, D, and E ; (2) the types of weave effect of which such styles are composed ; and (3) the range of contrasts in textural detail of which designs of this class are illustrative.

Relative to the dimensions of the lines—in Fig. 132 sections A consist of 8 threads, section B of 64, and section C of 16 threads ; in Fig. 133 the lines are of two sizes, A and C representing the first, and B the second portion of the design ; in Fig. 134, striping, A and B consist of 9 and 8 threads, C of 34, D of 18, and E of 27 threads ; and in Fig. 135 the upright twilled features B, C, and D are equal in width to the section A.

Examples 132, 133, and 134 indicate the kinds of weave obtainable from a common twill and suitable for combination with each other in striped arrangement ; and Fig. 135 indicates the practice of employing one twilled unit, A, varied in composition by drafting, in the origination of an interesting compound style.

179. *The Combination of Weaves of Different Interlacing Principles.*—While, as shown, there is scope in the use of a

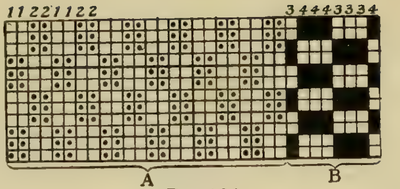


Fig. 131

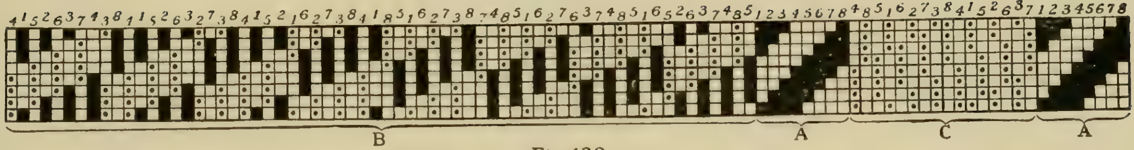


Fig 132

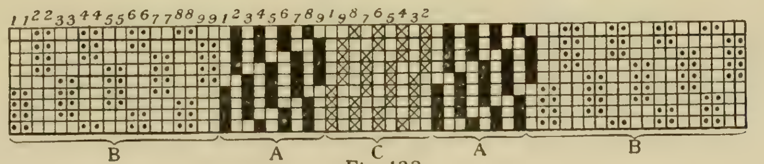


Fig. 133

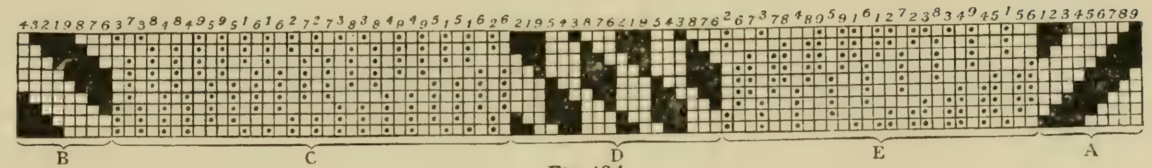


Fig. 134

EXAMPLES IN DRAFTED DESIGNS.

common weave unit by drafting for the production of several varieties of striping, yet, as may have been observed, they have necessarily one element in common, inasmuch as they result from combining threads of a corresponding intersection formula. Each stripe in Figs. 132 to 135 consists of the regrouping of the threads of the basic weave, or that in section A. In other words, the threads of which this basic weave consists, restrict the number of thread units of which the weaves derived, by changing the healding order, may be composed.

The design principles now to be explained, admit of the combination of several weaves differing in scheme of interlacing. The plain make, may, for instance, be used with the sateen, the twill, and the mock leno ; and ordinary and fancy twills with mat, diamond and other crossings. Great diversity of fabric structure and of pattern style is therefore obtainable, because the weave in each line of effect of which a pattern is formed, may be the result of a special plan of intersection. The stripings included in this system of designing may be classified into—

(1) Fine-line stripes.
(2) Stripes in twills, moving at different angles.
(3) Stripes in which the plain make is an ingredient.
(4) Muslins, zephyrs, and lustres.
(5) Fancy and special weave combinations.
(6) Inverted weave stripes.
(7) Small figured stripings.
(8) Lace stripings.

It will be understood that, if the weaves combinable should be dissimilar in the thread units of which they consist, the shedding mounting will accordingly be composed of a larger number of heddles. Instead of the mounting, as in the stripings considered, being restricted to the shedding units necessary in producing one weave type, it requires to comprise the several thread units of which the two or more weaves combined are made, that is to say, if the plain weave should

be worked into a stripe with weaves on six and twelve shafts, the minimum number of distinct threads of which the design would be formed, would be a multiple of these three weave units, namely, 20.

In dissecting this class of loomwork, it will be shown that particular weave plans, though adapted for the same or distinct shaft mountings, have certain threads in common; and that the designs, in which such weaves occur, are reducible to a number of heddles tallying with the aggregate of the individual threads comprised, or to a lower number than that represented by the multiple of threads in the two or more weaves combined. For instance, a compound pattern, arranged 24 threads of plain, 8 threads of plan C (Fig. 104), 16 threads of plain, and 12 threads of plan E (Fig. 108) would be producible on 16 and not 22 shafts, on account of six of the threads in plan E being similar to the threads in the plain make.

180. *Fundamental Features in Forming Weave Stripes.*— The fundamental features to be observed in the origination of this class of design are (1) the limitation, as far as feasible, of the series of shafts employed, with the acquirement, in the drafting, of a regular or practical system of healding; and (2) the selection of weave structures of a suitable character for making an effective style, and a satisfactory build of texture.

An explanation of these technicalities may be rendered by alluding to Figs 136, 137, and 138, the first a compound of 6-shaft and 12-shaft weave units, the second of two 4-, one 14-, and one 8-shaft, and the third of 8- and 16-shaft units. If all the threads in the weaves in Fig. 136 were distinct in interlacing plan, it would necessitate the use of 18 shafts; and, with each weave differing in thread formation in Figs 137 and 138, 30 and 24 shafts would require to be utilized; but in consequence of the 12-shaft make A, in Fig. 136, being partly composed of the threads in the twilled section, the shaft complement of this weave is reducible to 6, rendering the whole design weavable on 12 shafts. Then, by reversing the $\frac{3}{3}$ twill sections, and

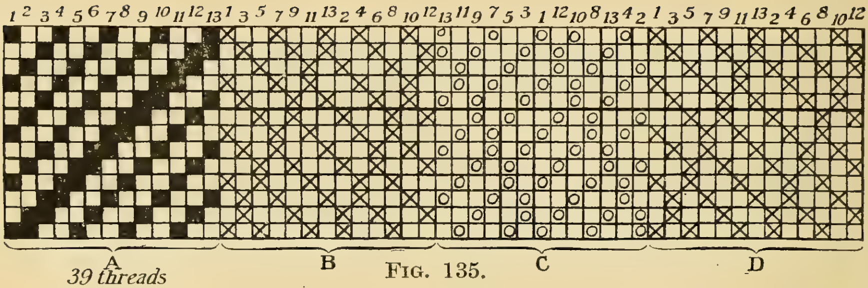


FIG. 135.

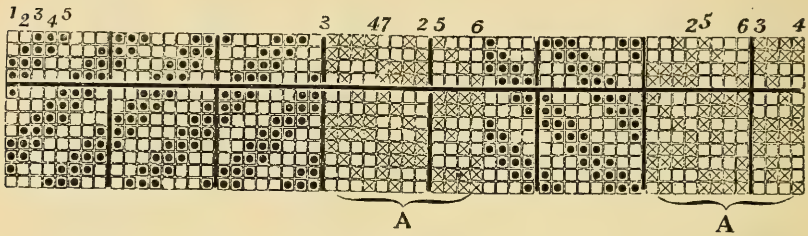


FIG. 136.

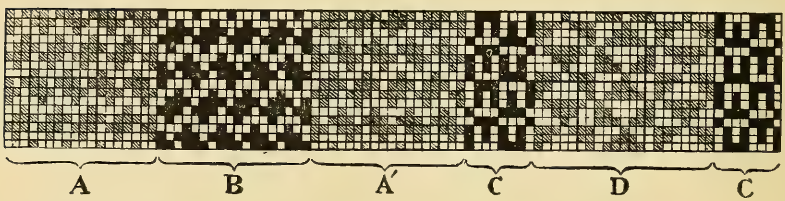


FIG. 137.

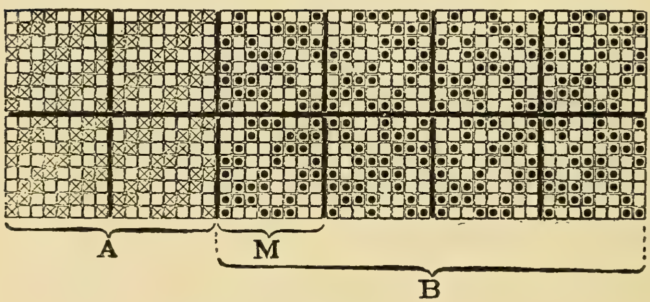


FIG. 138.

STRIPED DESIGNS DRAFTED.

also those of A, variety of weave type and style is acquired without adding to the range of the shaft mounting.

Similar technicalities obtain in the construction of Fig. 137, a pattern on 91 threads, and complete on 24 picks, and in which each line of effect is extensible or otherwise. For economic healding, threads A would be drawn on to shafts 1, 2, 3 and 4, B on to shafts 5, 6, 7, and 8, C on to shafts 9 to 16, and threads D on to shafts 17 to 23, but if a further reduction should be desirable, section C should be woven on shafts 9 to 12, reducing the whole design to 20 heddles. Providing the weave units selected, as in this illustration, do not tally with one another in the number of picks they occupy, the joining of the weaves together may involve the edging threads in the several stripings being slightly re-arranged. To do this on the threads in the repeated weave elements in the pattern (A, B, and D) would add to the shedding units applicable. It is therefore usual to modify the outside ends of the unrepeated weave in the style, or that in section C in Fig. 137. If here, for example, the irregular or four floats of weft on the 3rd, 12th, and 15th picks, should be found unsatisfactory in the fabric, the first and last threads of weave C would be so changed in the intersecting order as to eliminate the defect.

In Fig. 137, as a result of the intersections in weaves A and B being the reverse of each other, the two crossings require eight shafts, whereas the method of interchanging the orders of the threads and picks in section B of Fig. 138, gives a 16-shaft plan, weavable on half this number of shafts. The mayo crossing (the 8 threads lettered M), and also other regular interlacing weaves on 8, 10, 12, and a fuller number of shafts, are converted into designs of double the threads and picks of which they consist by the re-arrangement practice here adopted. For acquiring the 16-shaft plan from detail M, first the 9th to the 16th picks are compiled by commencing on the 4th pick, and reversing their sequence; then, for the 9th to the 16th threads of the plan, the threads of the extended section M are

re-arranged, commencing on the 4th and reversing serially through the weave.

Practising this system of designing gives a varied pattern style on a reduced number of shafts, for it follows that this 4-shaft and 16-shaft compound is producible on 12 instead of 20 heddles, which the two weave units theoretically represent. What is apparent in these three forms of stripings is, that the weave types combined may effectively differ in structure, whether considered as separate bases of cloth building, or as distinctive textural elements in broad striped patterns weavable in a convenient shaft-mounting.

The technical points named concern style quality as due to the plan of weave assortment. The several stripings in the designs are understood to be variable in order of grouping, and also in dimensions. The lines of effect seen in Fig. 136 may be doubled, trebled, etc., in size, and this also applies to Figs. 137 and 138. As the different effects are grouped, they form, however, interesting striped styles. Briefly examining Fig. 136, the broader twilled line consists of 24 threads of twill to the right, lines of modified mat, and lines of $\frac{3}{3}$ twill reversed. The matted details in crosses are equally adapted for the larger as the smaller sections of the design. Fig. 137 consists of three lines of equal width, A, B, and A′, of two small lines C, and of a medium-sized line D. The fine intersecting plan C is used in the smaller stripings, and the more open crossing D in the broader line. Should the twill, part A in Fig. 138, be striped with colour, it might be enlarged, which would change the character of the whole style, or a broader striping might be made in the interchanging mayo effect, B.

The relative widths of the stripes, and the order of grouping them, fix the style formation. Weave structures are selected which contrast with each other, and which are adapted in type to the textural qualities required. Thus, where the weave units, as in A and B, Fig. 137, are the reverse of each other, the stripes in each may be of a similar size, but in the case of weave C, a comparatively fast principle of

interlacing, it is adapted for the smaller stripe. In Fig. 136, both weaves being regular in structure, they are suitable for lines of equal or different sizes, and in Fig. 138, either the cassimere or the mayo may be used in making the broader or the smaller pattern lines.

181. *Fine Line Pattern Types.*—By combining plain with single or double threads of twill and cord weaves; or warp-face weaves—prunelle and $\frac{3}{1}$ twills and sateens—with single or double threads of reversed weaves, line stripings are produced. To obtain a correctly-balanced pattern and an evenly-made fabric, the threads of the reversed weaves, forming the line details, should follow in natural sequence as in Fig. 139, consisting of a stripe of prunelle twill C, and of a stripe of line effects D. In the latter, threads a', a^2, and a^3 are arranged in a regular weft twill order, and the warp twill is made to cut the single threads. Using two threads for the line elements (Fig. 140) and the $\frac{2}{2}$ twill for the ground of the pattern, the striping is varied by turning the direction of the $\frac{3}{1}$ twill as at *aa* and *bb*.

With a twill or plain weave in the ground stripings, the lines may be successively formed in warp and weft twill on the practice shown at *a*, *b*, *c*, and *d* (Fig. 141). The sections T may be enlarged as desired, with angled or matted features introduced, or they may be produced in plain, mat, and other standard weaves. With the use of the plain, the effects *a*, *b*, *c*, and *d* are frequently woven in a special quality of yarn such as silk with worsted or cotton for the ground; while, with twill as the basic weave, the lines may be distinct in colour or in yarn composition, from the yarns used in the rest of the warp. Such, however, is the difference in the weave construction of the ground features, and of the line details in these patterns, that the effects become sufficiently distinctive in quality and structure when produced in one counts of yarn.

182. *Stripes in Twills of Different Angles.*—In this variety of striping, there is considerable scope for the development of pattern style both in the use of different weaves, and in the lines

of effect combinable. Primarily, twills are used of a warp-face structure in which the twilled details are of a similar size, and

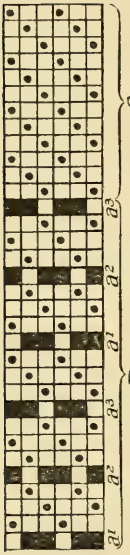


Fig. 139.

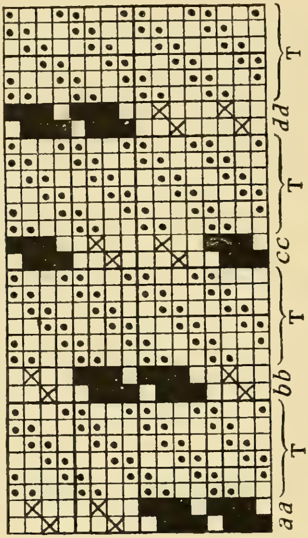


Fig. 141.

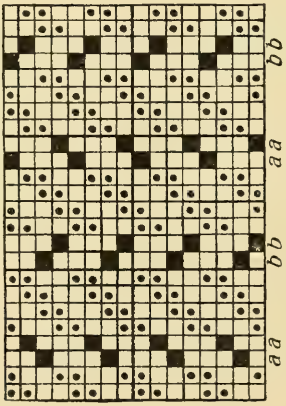


Fig. 140.

Examples in Line Striping.

run in a like direction, but at different angles. Secondly, the twills may consist of warp and weft effects with the details of each differing in size; and thirdly, warp-face twills may be

combined with ordinary twills, and also with fancy twills. Such designs comprise three groups of Weave Compounds, namely—

GROUP I.

Compounds of such weaves as the prunelle and ${}_{1}{}^{3}$ twills with the same weaves 2 picks in a shed.
,, ,, 4-shaft twills with the 8-shaft buckskin and other weaves.
,, ,, 5-end Venetian or garbadine with the 10-shaft buckskin, etc.
,, ,, 7-shaft corkscrew with the 7-shaft Venetian.
,, ,, 7-shaft warp twills with 9-shaft upright twills.
,, ,, 6-shaft whipcords with 12-shaft upright twills.

GROUP II.

Compounds of 5-shaft Venetian and 10-shaft small diagonals.
,, ,, 7-shaft warp twills and 9-shaft small diagonals.
,, ,, 8-shaft ,, ,, ,, 8-shaft ,, ,,
,, ,, 9-shaft ,, ,, ,, 9-shaft ,, ,,
,, ,, 11-shaft ,, ,, ,, 11-shaft ,, ,,

GROUP III.

Compounds of ${}_{2}{}^{2}$ twill with ${}_{3}{}^{1}$twill, 2 picks in a shed.
,, ,, ${}_{2}{}^{2}$,, 8-shaft buckskin, warp twills and fancy crossings.
,, ,, ${}_{2}{}^{3}$,, 5-shaft and 10-shaft warp twills and diagonals.
,, ,, 8-shaft buckskin with weaves on a sateen base, and with special makes.
,, ,, ${}_{3}{}^{3}$ twill with whip cords, 12-shaft upright twills, etc.
Modified corkscrews, with ordinary and upright warp twills.
Diagonal corkscrews, with twills and derivative-twill crossings.

The first group of these stripings are specially adapted for neat, fine twilled patterns, in worsted yarns for costumes, and, in silk, cotton, and linen, for the closer-set varieties of dress goods. The two examples, weavable on six and nine heddles, given in Figs. 142 and 143, are formed respectively of two and three weave units. The lines of each weave may be modified to agree in width with the style of manufacture intended. With differentiations in the interlacing order on which the plans are constructed, it is the practice to vary the setting, making this correspond with the structure of the several weaves applied.

The reeding is fixed for each type weave in the style, that is to say, in Fig. 144, with 72 threads per inch in A, there should be 84 to 90 threads per inch in B.

The variations in the angles of the twills, and the contrasts in fineness of the lines in each weave, form the distinctive pattern qualities. In Group I, the design features result purely from these sources; but, in Group II, the weave units develop other textural details than those due to the angle of the twills; and in Group III certain of the stripings are woven

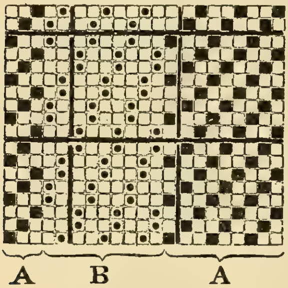


FIG. 142.

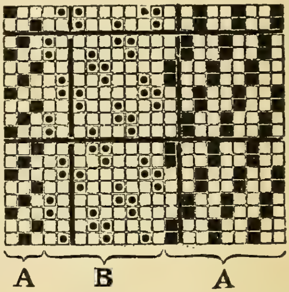
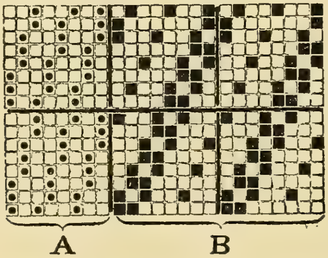


FIG. 143.



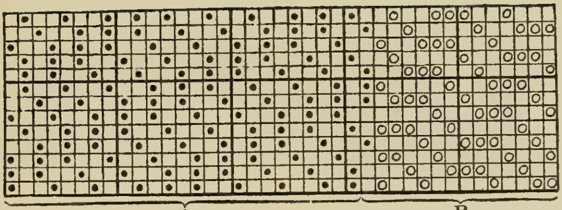
For 16 *threads.* *For* 32 *threads.*

FIG. 144.

COMBINATIONS OF TWILLS RUNNING AT DIFFERENT ANGLES.

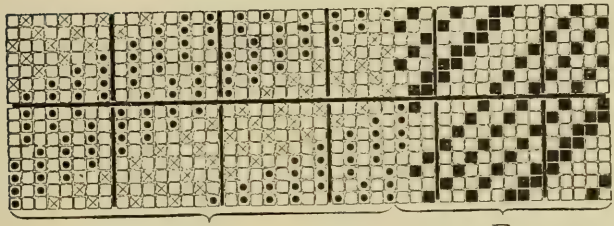
in twills which give weft as well as warp effects, while other stripings in the designs consist of warp-face twills. Each class of combination is illustrated—first in Figs. 142 and 143, second in Figs. 144, 145, and 146, and third in Figs. 147 to 150.

The lines of effect A in Fig. 142 traverse the cloth at 45°, and those in B at 60°, and in Fig. 143 the same two weaves



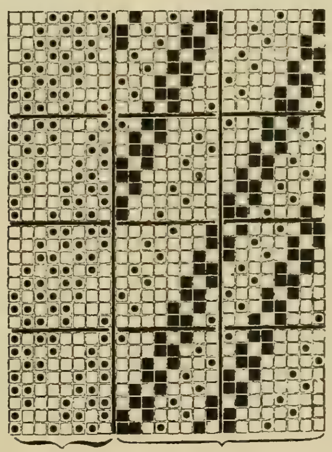
A B

FIG. 145.



A B

FIG. 145A.



A B

For 16 *threads.* *For* 32 *threads.*

FIG. 146.

COMBINATIONS OF TWILLS RUNNING AT DIFFERENT ANGLES.

are used, with a third weave C, forming an intermediate type of twill. The finest contrasts, in such warp-face twilled stripes, are obtainable when the weaves are constructed on a similar base, as, for example, in D and E, Fig. 103 ; in A and B, Fig. 105 ; and in A and B, Fig. 106 ; or in two weaves of a like structure, but occupying different numbers of threads, as in the instances of compounds of the Venetian and the 10-shaft buckskin, and of the 6-shaft and 12-shaft whipcords. The second description of pattern affords considerable facility

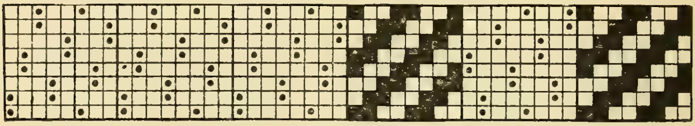


FIG. 147.
STRIPES COMPOSED OF VARIOUS WEAVES.
(See Figs. 142 to 150.)

in the choice of plans weavable in corresponding shaft mountings, such as two 6-shaft, two 8, two 9, and two 10-shaft units ; or larger makes according to the shedding capacity available. Figs. 144, 145, 145A, and 146 typify this principle of design. The first of these examples is composed of a fine twill effect in section A, of and a small diagonal effect in section B. The grouping adopted is 16 threads of the former and 32 threads of the latter, but this technicality is changeable with the kind of striping desired.

In Fig. 145, 13-shaft weaves are used. The weave in section B is the inverted form of that in section A, which is a principle applicable to twilled weaves constructed on the sateen base, giving, in this illustration, a warp-cord twill in the first, and a weft-cord twill in the second striping, and forming respectively oblique and upright twilled effects in the fabric. A modification of this class of striping is shown in the undraftable compound (Fig. 145A) where the diagonal, in part A, runs at an angle of 27°, and is combined with a 15-shaft twill.

In applying plans occupying different multiples of threads,

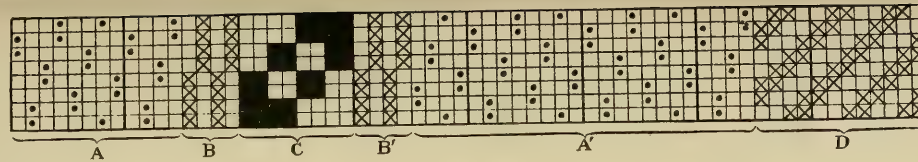


FIG. 148.

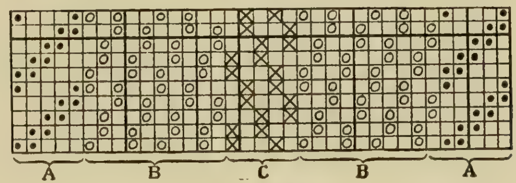


FIG. 149.

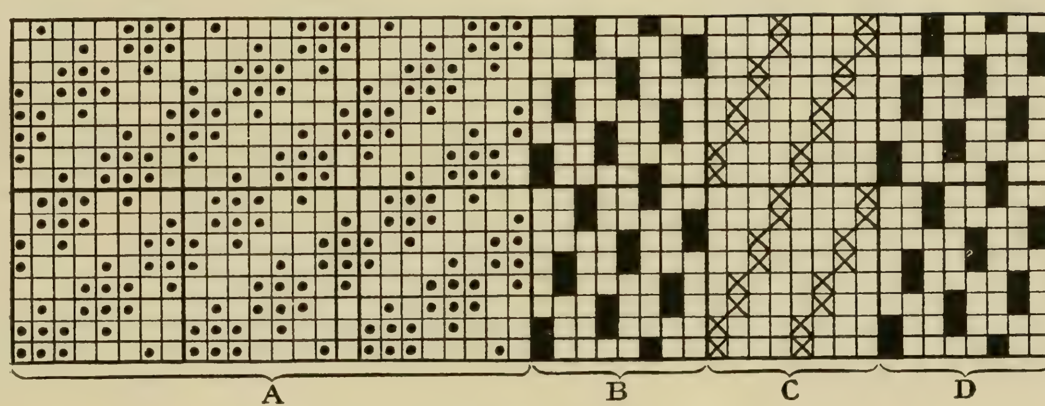


FIG. 150.
STRIPES COMPOSED OF VARIOUS WEAVES.

certain twilled features may run at a like angle as in the warp-floated twills in Fig. 146. The linking of the details of one plan with those of another plan on this principle, causes certain twills to move regularly through each striped line in the pattern, with, however, the formation of the complete series of twills, in each effect, as in A and B of this design, differing in detail and in structure. In originating the strippings, the constructive lines and features in the several weaves are the chief essential, in association with the plans being of a structure to weft satisfactorily together.

In the third series of these examples, each line of effect may be made distinctive in character, which partially arises from the employment of twills in which the warp and weft interlacings are equal in size, with twills producing an excess warp effect on the surface of the fabric. Four typical patterns will be examined, Figs. 147, 148, 149, and 150. Fig. 147 is made up of two sorts of line, namely, buckskin and $\frac{2}{2}$ twill; Fig. 148 of lines A.A′, buckskin; lines B, warp cord; line C, fancy 8-shaft mat; and line D, cassimere twill.

The standard 5-end twill is suitable for combining with the Venetian as in Fig. 149, where the latter is twilled in two directions. For obtaining an even emphasis of the right and left-hand twills, B and C the warp yarns in B should be left-hand twine, and in C right-hand twine. This practice of thread grouping is observed in the manufacture of fine twilled fabrics for giving equal accentuation of the twills when moving in reverse directions.

Another system of warp-yarn arrangement, as to the direction of the twine in the thread in relation to the twills, is to use two varieties of twist for developing the twilled features, alternately, in clear and indefinite tones.*

Assuming this method of work should be applied to Fig. 148, stripe A¹ might be arranged—8 threads with the twist in the yarn to the left, 8 to the right, and 8 with the yarn twine to the left. If this were done the twill, in the two outside

* See Chapter V: *Woollen and Worsted.*

groups of warp threads, would be distinct, and in the central section subdued. The method of producing diversity of weave detail, and yet of retaining the twilled features as distinctive of the pattern form, is suggested more particularly in Fig. 148, the warp cord, B, and broken mat, C, yielding a striped element in contrast with the details in buckskin and $\frac{2}{2}$ twill. Fig. 150 is interesting, first, in the use of the fine warp-twilled lines due to B ; and, second, in the more open warp twill due to C—two upright twills, in one of which the twilled lines make an angle of 63° in the woven texture, and in the other an angle of 70°, with both types of effect in pronounced contrast with the hopsack twill applied in section A.

183. *Uses of Plain Make in Striped Designs.*—The plain make is largely used in striped designing, as it is one of the commonest weaves employed in the ground of many varieties of figured dress goods. The alternate grouping of its intersections causes it to fit correctly with every class of crossing. For this reason it is frequently introduced into compound weave patterns for joining one weave element with another in a symmetrical and even order. Its insertion in this way prevents irregular flushes in the use of either warp or weft plans differing in interlacing formation. Thus, in the combination of diamond, waved, mock leno, sateen and special types of weave, and also of warp and weft twills and sateens, its employment enables pronounced textural contrasts to be acquired, and yet a level and satisfactory fabric produced. The manufacture, therefore, of the lighter makes of striped and figured dress and blouse cloths is facilitated by its selection, either as the principal or lesser ingredient of the style.

The subject will be illustrated and explained by examining the principles of pattern origination as they relate to muslin and zephyr stripes, artificial silk weft goods, and lustres of various qualities and schemes of figuring. Gauze, cellular, lappet, and other typical builds of cloth, in which the plain weave is selected for the ground, will be dealt with later.

Suggestive examples of the former are given in Figs. 151 to 160. The woven specimen (Fig. 151) is produced in cotton warp, and wefted 6 picks of cotton and 4 picks of artificial silk. The warp threads are sleyed two in a dent in stripes A and B, with several empty dents intervening at C, edged by two ends of grey cotton. It will be noted that the difference in the lustrous nature of the silk and cotton shuttling yarns, adds tone and textural detail to each of the stripings. The style

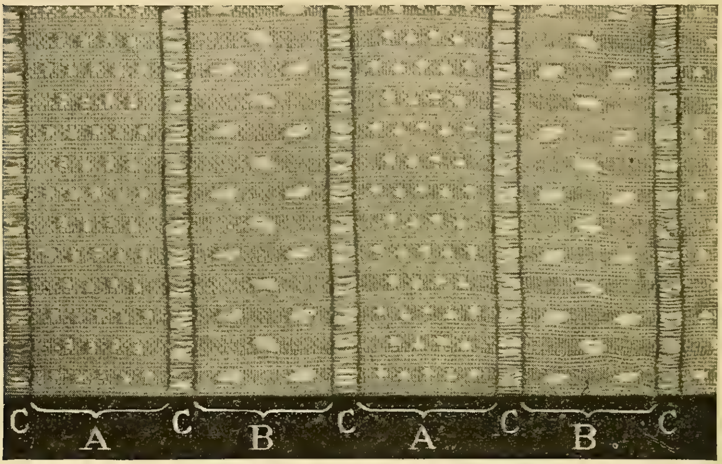


FIG. 151.—SPOTTED AND DENTED STRIPE.

thus obtained is due to a simple weaving practice, that of forming a distinction in the weft effects, and to the degree in which the silk picks are floated on the face, for developing the spottings in the lines A and B. In A these picks form small weft features similar to the star details in section A of Fig. 171; while in B the floating weft runs in twilled order for three picks in succession. Any weave but the plain would be less adapted for producing the fabric fineness and structure, which in this specimen give distinctiveness of character to elementary pattern types.

184. *Mock Leno Stripings.*—The mock leno is combined with plain, sateen, and mat weaves in the construction of muslin

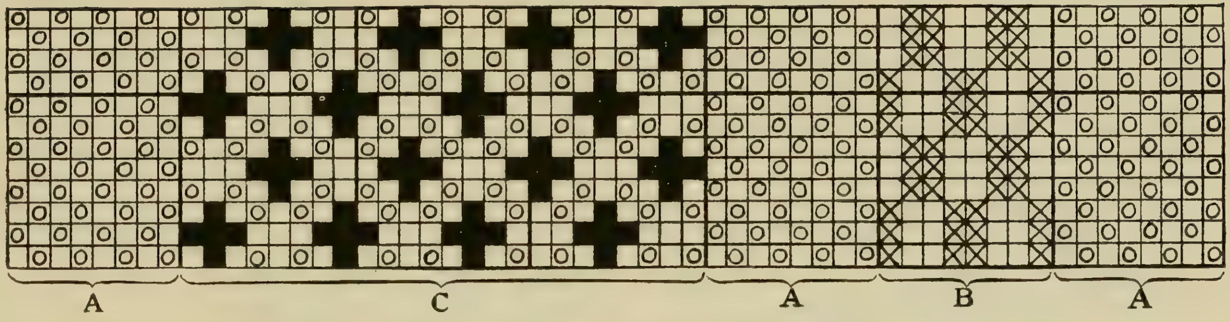


Fig. 152.—Mock Leno, Plain and Elongated Mat Stripe.

stripes. As in Fig. 151, the reeding practice followed is an important technicality for imparting quality to the effects in this class of weave-striping. The leno sections in C, Fig. 152, require to be sleyed 3 ends in a dent, and the mat should be woven with 2 threads in a heald, and sleyed 4 threads in a dent, but splitting identical thread units in the weave. By this grouping of the threads in the healds and in the sley, the cellular structure of stripings C, the fast structure of stripings A, and the hopsack elements in B, contrast strongly with each other in the fabric. Assuming a combination of 40 threads of plain, 30 threads of imitation gauze, 40 threads of plain and 24 threads of 6-end sateen, the two former might be appropriately reeded as indicated, and the sateen reeded 3 threads in a split. In this way the fineness of setting, necessary to the development of a smooth, full, sateen stripe, is acquired with the special setting for the leno weave, and the regular setting for the plain intertexture.

185. *Zephyrs and Lustres.**—Cotton zephyr patterns are the result of combining weave plans in which either weft (Fig. 153) or warp and weft effects are utilized with the plain make. Both these designs are arranged on a striped base, but in section B (Fig. 153) the design elements are formed in three and five floats of weft, while in section B (Fig. 154) they are alternately woven in floats of weft and warp. With the weft as the figuring or pattern yarn, this principle of loomwork is applicable to lustre dress stuffs, with a cotton warp and alpaca or mohair weft ; and also to light blouse textures, with cotton yarn in the warp and silk or artificial silk as the shuttling yarn. On either system the designs may be suitably elaborated, and yet restricted, as in the examples, to heddle weaving.

Figs. 153 and 154 are draftable on to 14 shafts, and are susceptible to further modification in design features by the method of drafting followed ; or other effects are formable on 10, 14 or 16 shafts for the decorative details, with the

* See *Union Textile Fabrication.*

addition of two shafts for the plain section A, should striped styles be produced.

186. *Warp and Weft Pattern Effects.*—Designs illustrative of

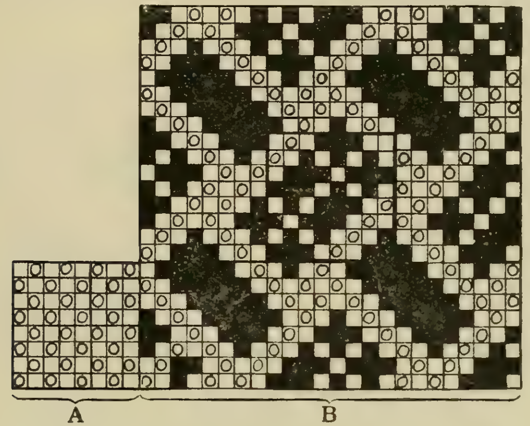


FIG. 153.

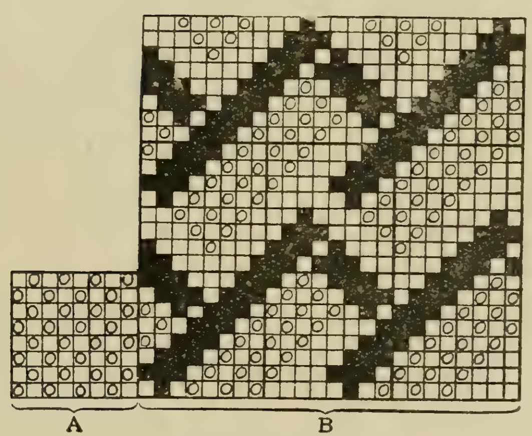


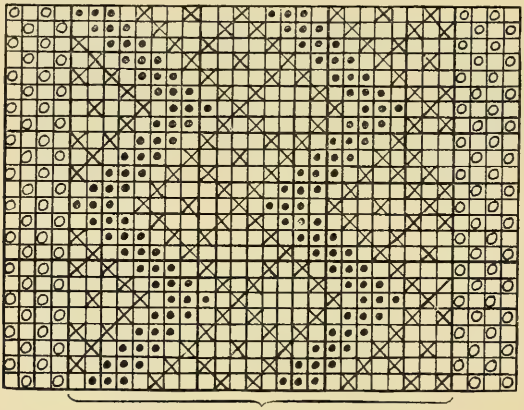
FIG. 154.

FANCY WEAVES AND PLAIN WEAVE COMPOUNDS.

the styles of effect obtainable when both the warp and weft threads are employed in producing textural ornament are sketched in Figs. 155 to 160. The examples (Figs. 155 and 156) are respectively composed of waved and diamond features,

the first consisting, in the space between the waved lines, of warp diamond details; and the second, in the intermediate spaces between the larger effects, of structural plans developed in floating threads and picks.

The width of the plain band, and also of the decorative stripings, is changed according to the style of pattern desired. Without extending the heddle capacity in the loom, more diversified weave elements may be combined, as seen in Fig. 157, a compound pattern on 68 threads, and producible



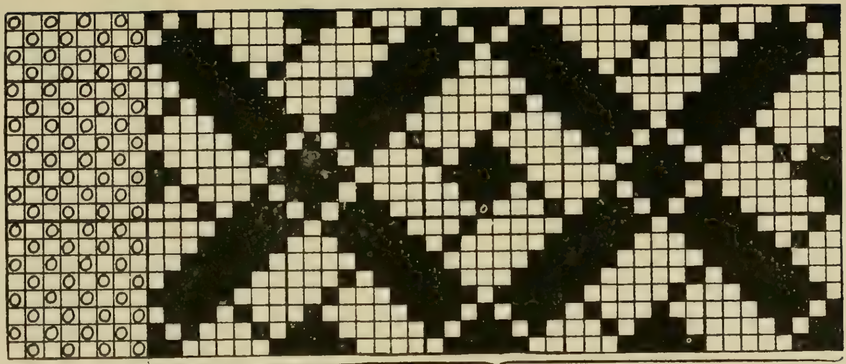
B

FIG. 155.

FANCY WEAVES AND PLAIN WEAVE COMPOUNDS.

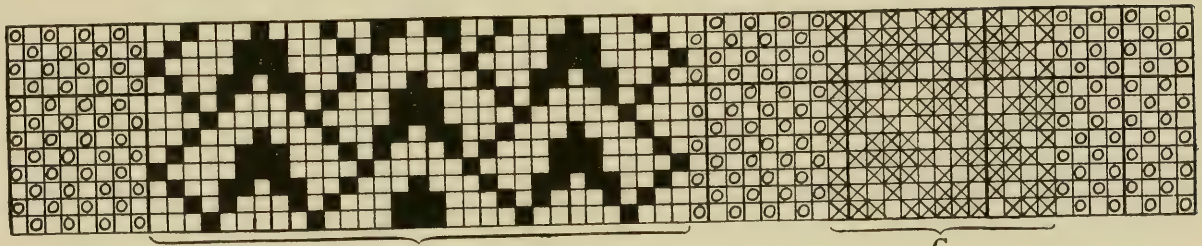
on 13 shafts, stripes B on 7, C on 4, and the plain features A on 2. Here the warp and weft details, differing in structural formation, constitute types B and C, the former being a species of heart-shaped figuring woven in warp and weft floats, and the latter a simple diamond effect woven in weft yarn.

The enlargement of the heddle mounting enables this principle of design composition to be increasingly elaborated, and varied in the weave units, as illustrated in Fig. 158, where, by drafting in the picks as in the threads, the figured forms in section B might be developed successively in diamond types, and on the pointed base shown. As the style is constructed,



B

Fig. 156.



B C

Fig. 157.

Fancy Weaves and Plain Weave Compounds.

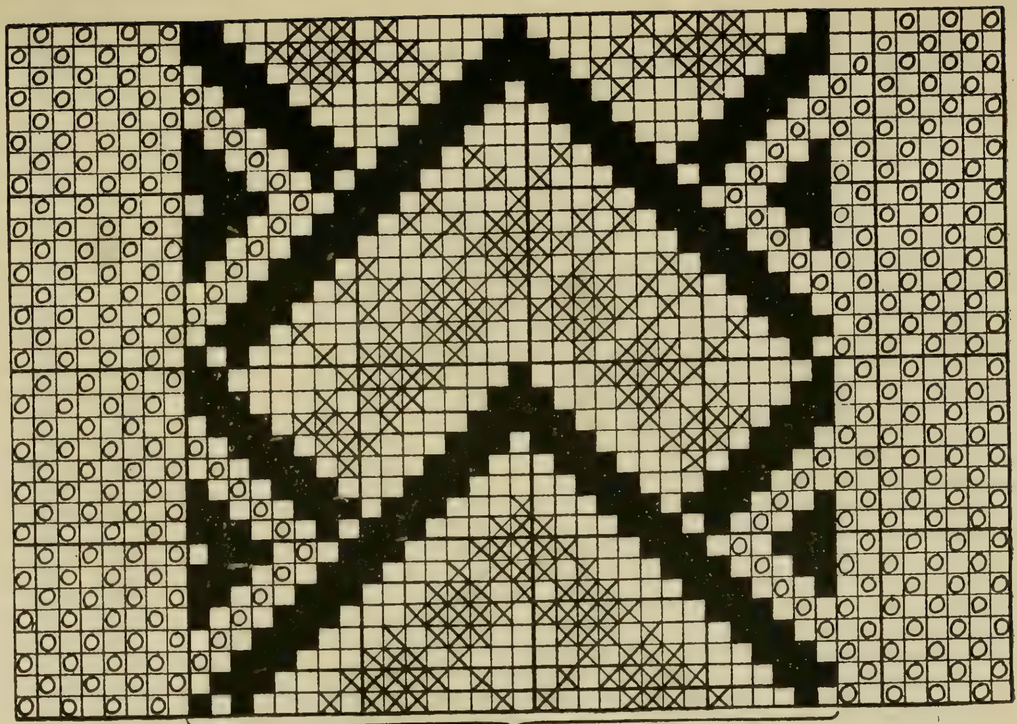
it is weavable on 18 shafts. Another species of detailed striping, more particularly applicable to silk warp and weft fabrics, is that produced in Fig. 159. While section B, in this instance, is not draftable, it might be used sectionally in the formation of a larger description of striping than that in which it appears. Combining for example—

30	threads of	plain,
8	,,	shaded twill B to the right,
10	,,	plain,
8	,,	shaded twill B to the left,
10	,,	plain,
8	,,	shaded twill A to the right,
30	,,	plain,
24	,,	section B,

would result in a broad striped pattern varied in line width and in textural effect, and yet draftable, like Fig. 159, on to 18 shafts.

The type of spotted stripe in Fig. 160 is suitable for textures in which the warp and weft are of equal value in developing the design structure. It might, however, be used for cloths in which the spots are formed solely in the weft yarn, by running a 2-and-2 weft cord over the warp surface sections in the plan. Using it as illustrated in silk or cotton cloths—piece dyes, or loom-coloured manufactures—produces the richer variety of pattern. The spottings are grouped on the 8-end irregular sateen plan of distribution, and their structure makes it feasible for the complete striped design to be woven on 18 shafts. Enlarging the spots and changing them to diamond or lozenge shape does not add to the number of heddles required.

187. *Fancy and Special Weave Stripings.*—From the examples given in the different forms of weave compound, it will be clear that the range of plans, constructed on the series of shafts illustrated under Figs. 102 to 112, in addition to the derivatives of the common twills, are suitable for combination purposes. Some of the examples, considered as sectional but decorative parts of striped fabrics, are, moreover, suggestive of the latitude provided for "weave" design in this class

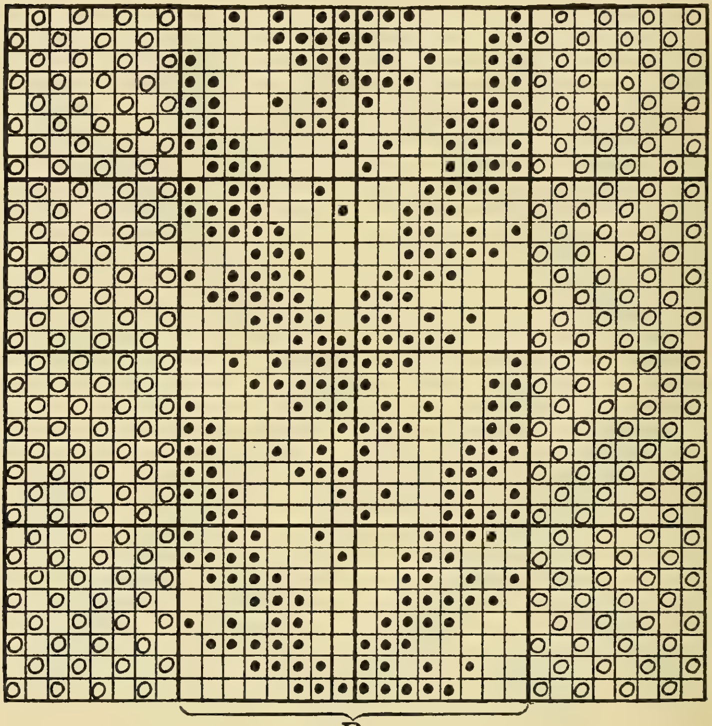


B

FIG. 158.
FANCY WEAVES AND PLAIN WEAVE COMPOUNDS.

of loomwork. Further, there is the variety of special weave structures available for application, with elementary types of crossings, to patterns of a striped description.

Three illustrations (Figs. 161, 162, and 163) may be referred



B

FIG. 159.

FANCY WEAVES AND PLAIN WEAVE COMPOUNDS.

to, as they show, first, that these are, in reality, textural designs ; second, that the weave units with which they are combined should accentuate and bring out their characteristics ; and, third, that, in the case of the special makes being of a regular type, the weave details, inserted into the composition of the complete pattern, vary in a large degree in principle of intersection.

To examine the three schemes of design, the special weave plan in Fig. 161 is based on the key pattern, the divisional lines of which are woven in plain, and the rest of the effects in even floats of warp yarn on the face of the fabric. Designs thus constructed, produce the features developed in the warp, on the right side of the cloth, and in weft on the under side, so that they are reversible in appearance as to warp and weft

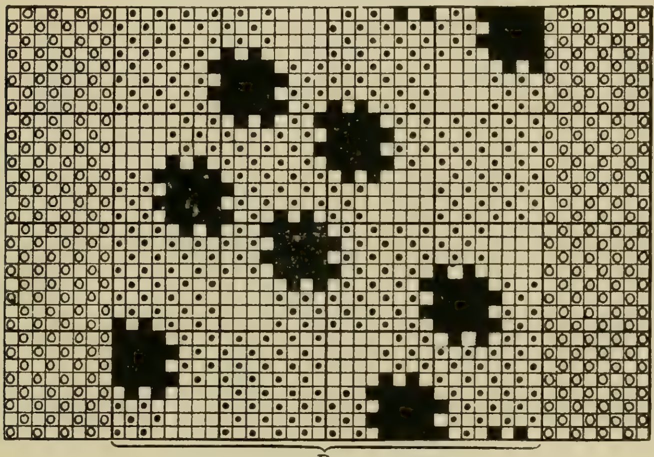


FIG. 160.—SPOTTED AND PLAIN WEAVE STRIPE.

qualities, but have a like form of decorative structure on both surfaces. The warp cord, in sections A and B, is, consequently, the correct weave to employ in this kind of striping, for it contrasts with the scheme of weave interlacing in sections D and E, and yet gives a species of clear, smart effect that adds precision to the decorative elements of the key pattern. A twilled weave would also be applicable, but it would increase the shaft mounting, and be more likely than the cord to impinge on the particular order of design details of which the larger stripings are composed.

An inverted zig-zag plan is the special weave type used in example Fig. 162, and in combination with elongated mat and irregular cord crossings. As the pattern, in band A, consists

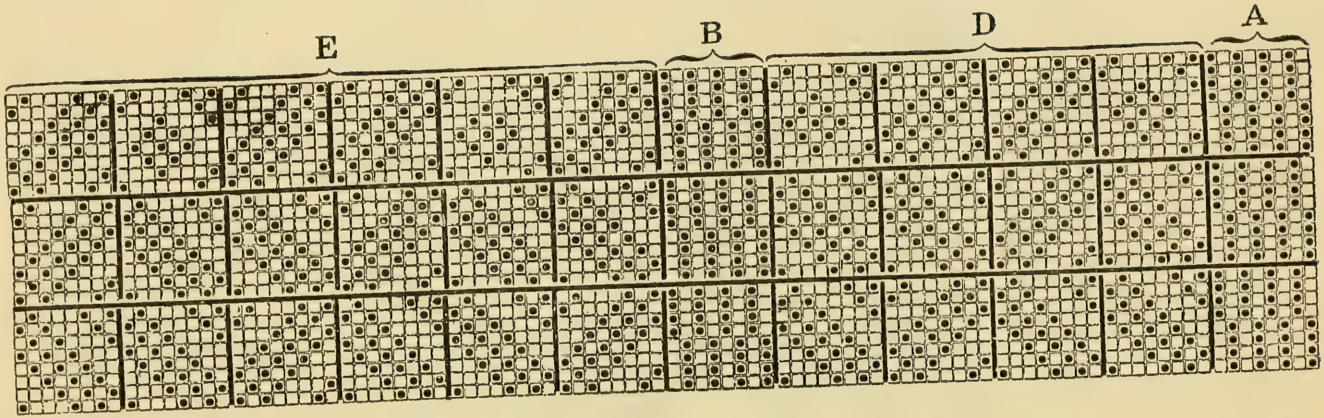


Fig. 161.—Key Pattern with Warp-Cord Striping.

of diagonal lines developed in $\frac{1}{3}$ and $\frac{3}{1}$ twills, it comprises a variety of twilling which should form the true decorative feature of the pattern. This being so, mat and repp are the types of crossing suitable for the smaller lines of effect in B and C. Either the repp or the mat might have been used in contact with the waved diagonal, but the mat, as arranged in this composition, gives a neat and effective edging which, in conjunction with the minute lines C, develops the design elements in the broad and principle stripe.

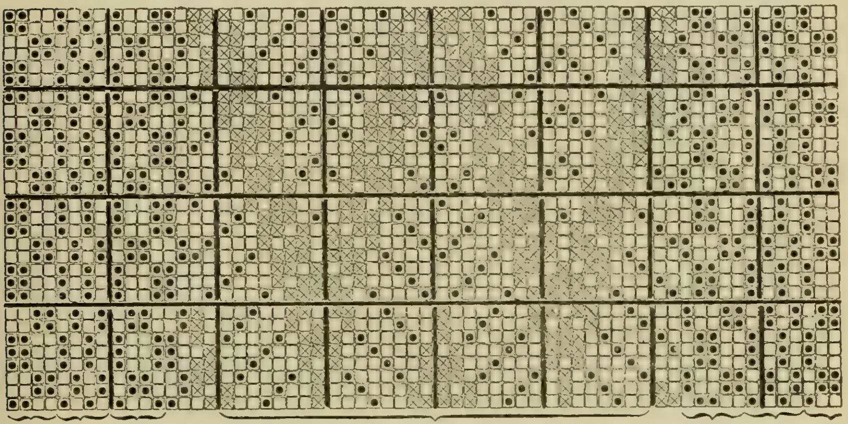


FIG. 162.—ZIG-ZAG DIAGONAL AND MAT AND CORD STRIPE.

Fig. 163 is still more varied in weave character, stripes E being formed in $\frac{4}{4}$ twill cutting, B in weft rib, C in serpentine weft cord, and D in 4-and-4 warp repp. Plans C and E may both be defined as the special types of weave in this style, for each produces a particular class of effect in the compound pattern. The idea, however, in originating the style, has been to form a smart line of effect in an interesting but regular weave, with smaller lines of contrasting detail, and this is seen to be the result of the divisional line D in warp cord and of the intermediate line C in weft detail, balanced by the pronounced weft rib, line B.

It is by thus considering the character of the pattern as a

whole, and the distinctive elements it comprises in the weave structures combined, that the design originated, gives, in the first place, the quality of striping and of detail features required, and, in the second place, an evenly built fabric.

188. *Inverted Weave Structures.*—Only two types of these patterns need be examined, those illustrated in Figs. 164 and 165. The first exemplifies the principle of constructing an effect in weft on a warp ground, namely, striping A, and of

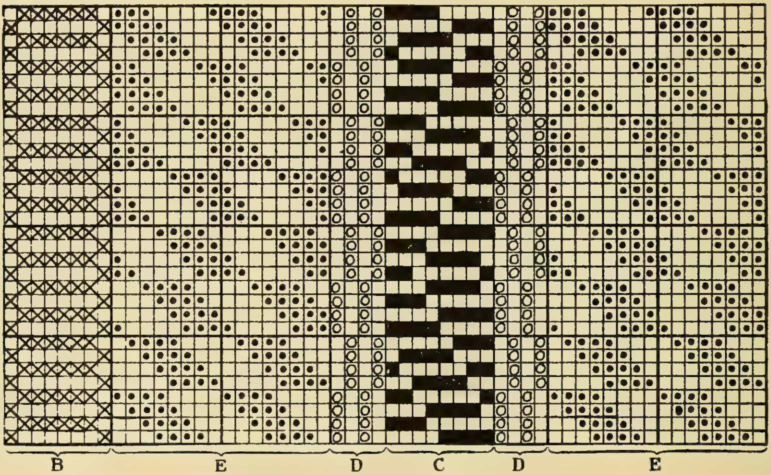


FIG. 163.—STRIPE COMPOSED OF FOUR WEAVE UNITS.

inverting this in the construction of the style. Hence, in such types of pattern, the alternate stripings have warp and weft flushed grounds.

On the weft surface, in Fig. 164, warp spottings are formed, and on the warp surface weft spottings. A degree of contrast in the textural and pattern effects is thus secured. The arrangement is simple, but capable of various modifications. Sections A and B might for example be repeated for three or four times, and formed into lines of different widths, or the whole design might be enlarged without adding to the shafts required in the weaving. Provided it is employed as printed, and woven in a light shade of warp and in a medium shade of weft, then

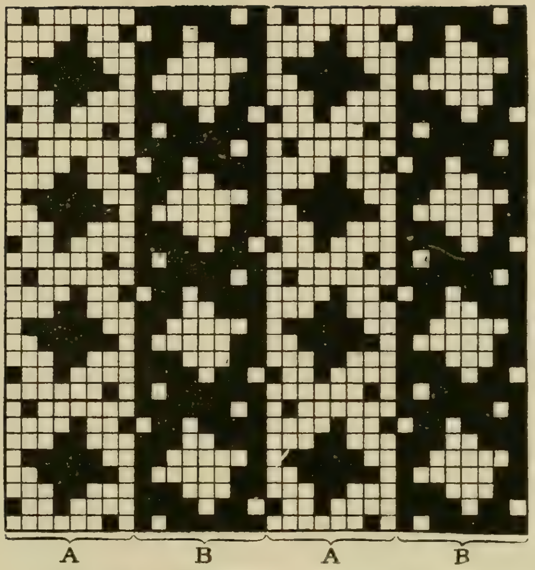


FIG. 164.—INVERTED STRIPED DESIGN.

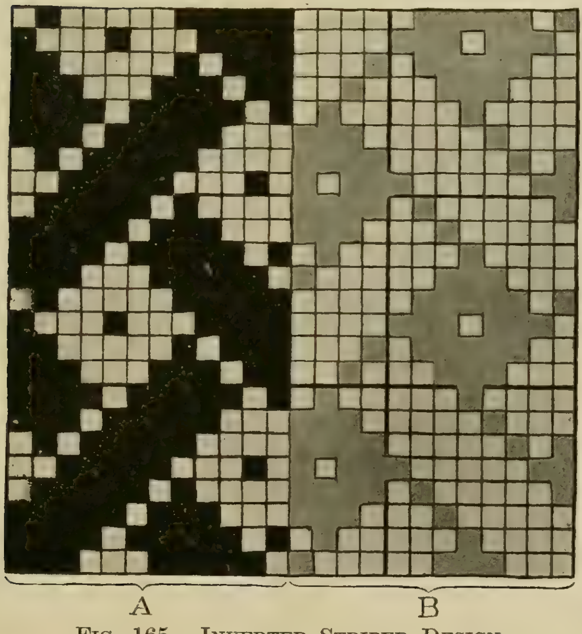


FIG. 165.—INVERTED STRIPED DESIGN.

stripes A would, in the fabric, consist of a light coloured ground, ornamented with spots in the medium colour, with stripes B produced in a medium colour in the ground, and spotted in the light colour.

Fig. 165 is typical of a second practice, that of selecting a warp or weft face plan, and of inverting it to make a striped pattern. Section B in Fig. 156 also lends itself to this method of treatment, which may also be carried out in all weave designs in which the warp threads develop a group of textural details, distinct in formation from those woven in the shots of weft. Another method of varying this description of style is that of inserting between the two effects of which the patterns are composed, or between the repetitions of each effect, lines of plain, twill, or fancy weave, which may be separately tinted in the warp for the purpose of imparting clearness of definition to the different features, due to the reversed plans, as well as of importing diversity of toning to the striping as a whole.

189. *Striped Figured Designs.*—When limited in the design range to 24 or 32 threads, as in the employment of heddle mountings, the styles of figuring obtainable are necessarily of a simple character, and free from detail forms. The patterns in the loom—not draftable, as a rule, to a smaller number of shafts than the number of thread units of which they consist—rarely exceed a small fraction of an inch in width. Considering this factor, and that of the decorative types being the product of the interlacing of the warp and weft threads in a prescribed order, or an order which gives a correct build of fabric, such geometric and conventional forms as may be utilized require to be of a miniature kind ; yet it is possible, by exercising skill in the shaping of the figures, and in the planning of these on point paper, to produce a fair range of styles, differing in decorative quality and composition, and also distinct from the styles characteristic of pure " weave " design and arrangement.

Referring to the three examples in Figs. 166, 167, and 168, the figured sections A are weavable on 24 healding shafts. In

the first, a plain stripe is combined with the pattern details; in the second, a cassimere stripe with the decorative features; and in the third, stripes of warp and weft sateen are combined with a stripe in warp sateen spotted with floats of weft.

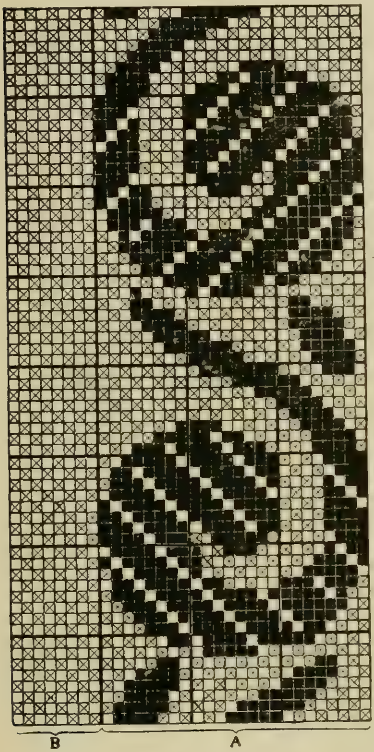


FIG. 166.

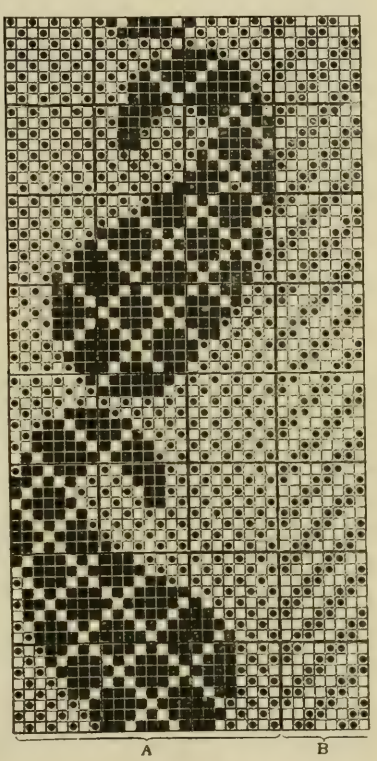


FIG. 167.

SMALL FIGURED STRIPES APPLICABLE TO SHAFT MOUNTINGS.

Each pattern makes a particular type of elementary figuring. That in Fig. 166 is composed of curvilinear forms expressed in 5-end weft twill with the ground in plain make; that in Fig. 167 of small pine figures, and that in Fig. 168 of conventionalized floral features developed in two kinds of twilling

on a 5-end sateen ground. The decorative parts of these examples are weavable in dobbie mountings. Figs. 167 and 168 might be slightly reduced and worked out on 20 threads,

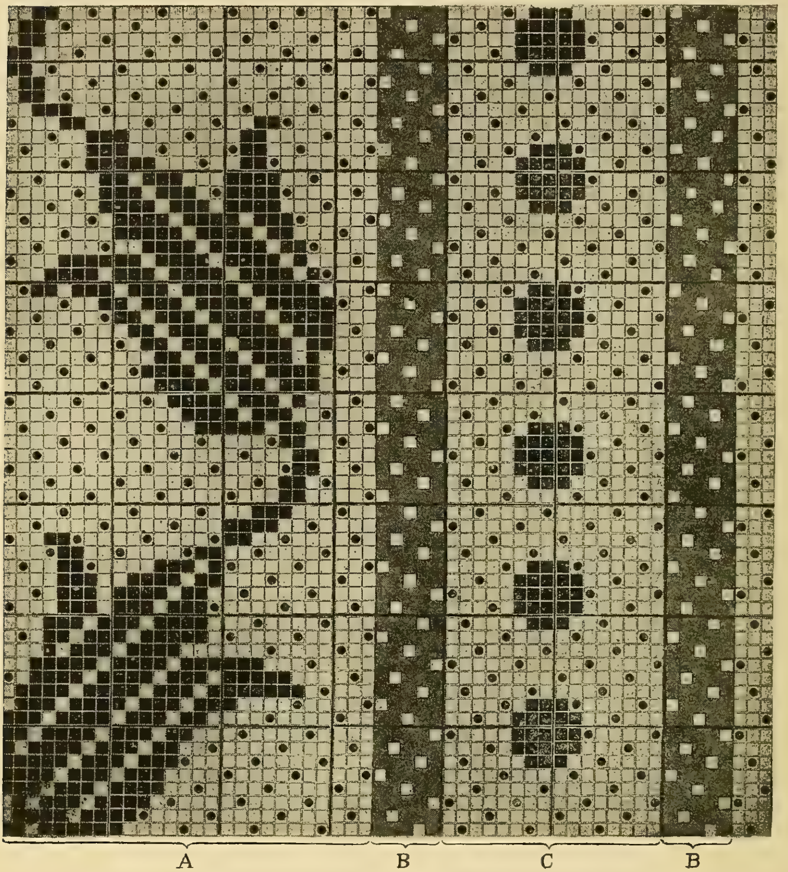


FIG. 168.—SMALL FIGURED STRIPE.

allowing 2 or 4 shafts for the plain or twilled stripe, so that they would be producible on 24 heddles. The supplementary stripings in Fig. 168 have made this pattern suitable for the harness loom, but should the weft sateen lines be eliminated, and the figured forms brought within 20 threads—which is feasible—the lines in warp sateen, and also the one in which

circular spots occur, may be retained, and the pattern constructed be woven in a 30-shaft gear.

Striped designs of this elementary figured description are used in the manufacture of light fabrics in silk and in cotton

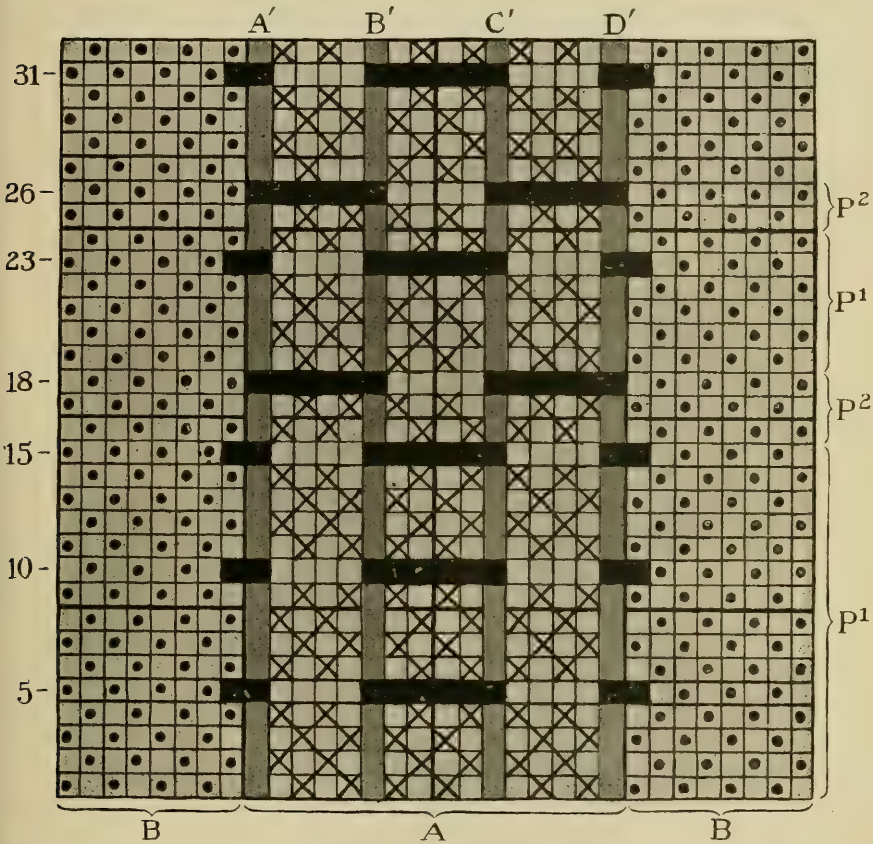


FIG. 169.—LACE STRIPING.

yarns, and in cotton warp crossed with an alpaca or artificial silk weft. If the designs should be constructed to be weavable in a centre-point healding draft, they would be doubled in size, or if weavable in a duplicated-point draft, they would be correspondingly increased in dimensions.

190. *Lace Stripings.*—In what are termed woven lace

patterns, certain threads of warp—usually delivered off a separate chain beam from the warp of the ground of the fabric—are formed into circular, oval, and other cellular shapes on the face of the cloth. Fig. 169A demonstrates the principle of inter texture comprised, and also the style of effects produced. The white yarns A^1 and B^1, C^1 and D^1 are here seen to give a species of network.

The design plan is that reproduced in Fig. 169, where section A represents the structural scheme, combined with the plain stripings B. From this it will be observed that the

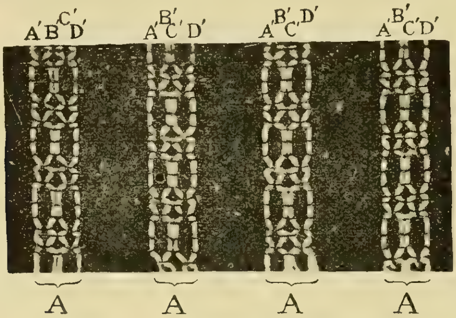
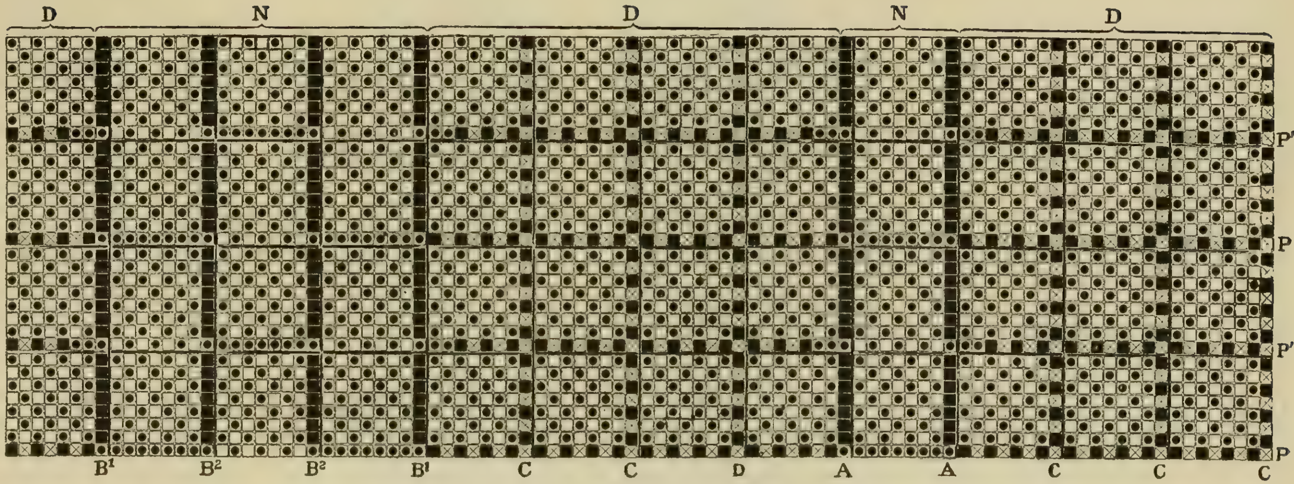


FIG. 169A.

lacing threads float loosely over a number of picks of weft in succession—the length of their floats determining the openness or closeness of the net, and also its diversified character. In section P^1, these threads flush on the face of the cloth over four picks, but in section P^2 over two picks—a method of shuttling which binds the lacing threads in two serial groups, of a greater and of a lesser formation, into the ground of the texture. The lacing picks are floated in such a manner as to link alternate pairs of threads to each other, that is to say, picks 5, 10, 15, 23, and 31 link the central lacing ends with each other, and picks 18 and 26 link central with edging threads. This practice in thread-linking originates the quality of the net woven.

Striped combinations, with plain interlacing as a chief factor, are worked into various styles on the system shown in Fig. 170. This design results in the type of effect sketched



In preparing for the loom lift □*'s and* ■*'s.*

FIG. 170.—LACE AND CHECKED STRIPING.

in Fig. 170A. Analysing the loom plan, and considering the threads A, B, and C, and the picks P and P^1 as distinct units from the remainder of the threads and picks composing the pattern, its structure will be more clearly presented. First, it should be observed that the cloth proper is plain woven, so that the netted striping N, and the checking details D in the sketch, are due to the supplementary threads and picks. Such yarns, by interlacing plain in section D, developed the checked features.

The lacework is caused by floating these yarns on the surface of the cloth, on the principle described in Fig. 169, and also by linking B^1 alternately with B^2, and an edging yarn, B^3,

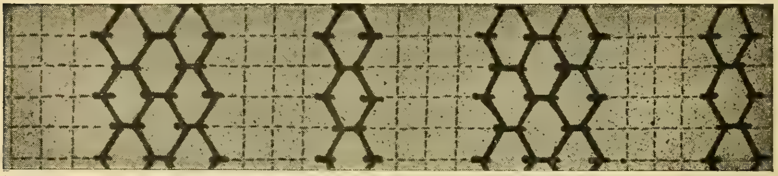


FIG. 170A.

alternately with B^2 and B^4, and B^4 alternately with a second edging yarn, and with B^3. Either the lacing, plain, or checking details may be repeated in any prescribed order, or the lacing effects may be combined with other design principles, one of which is illustrated in Fig. 171. This compound of crescent, star, and net stripings is reducible to a limited shaft mounting. It may be examined in relation to the following practice in manufacture—

Warp.

4	threads of	60's	cotton twist	or	60's	2-fold silk,	light fawn.
21	,,	60's	,,	,,	60's	,, ,,	light blue.
12	,,	60's	,,	,,	60's	,, ,,	light fawn.
1	,,	60's	,,	,,	60's	,, ,,	2 ends in a mail, fancy colour.
5	,,	60's	,,	,,	60's	,, ,,	light blue.
1	,,	60's	,,	,,	60's	,, ,,	2 ends in a mail, fancy colour.
8	,,	60's	,,	,,	60's	,, ,,	light fawn.

Sleying—Stripes B, C, and D, 2 threads in a dent, with the threads in ☒'s one end in a dent.
Stripes A, 4 „ „ and one dent empty on either side.

Reed—40 dents per inch.

Weft.

40's cotton or silk, white, or in a contrasting colour.

Considered in regard to weave elements, the design comprises several distinct types of crossings; firstly, there is the

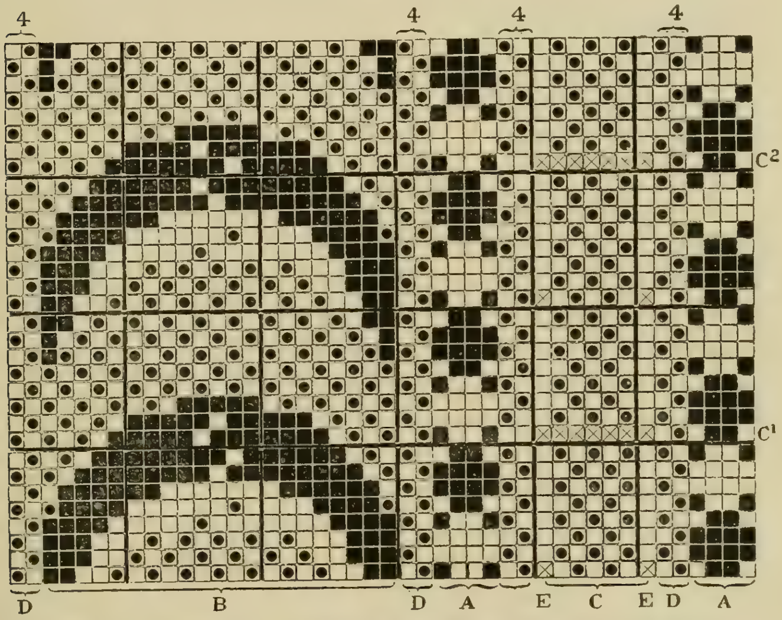


FIG. 171.—STRIPING IN WARP AND WEFT EFFECTS COMBINED WITH NET OR LACE DETAILS.

plain ground ensuring the construction of a level fabric; next there are the star stripings or leno effects A in warp and weft floats; and, in the third place, the lace and figured structures.

According to the colour scheme, the warp features in A would be in fawn, and the weft features in white. The larger band of effects B consists of crescent forms alternately woven in warp and weft effect. Light blue warp threads being applied

to this section, the elements marked in □'s would be in this tint, and those marked in ■'s in white. In addition, there are the lacing threads used in part C, which are, in the weaving, drawn into diamond or cross-over net. Such lacing threads require to be entered into separate dents in the reed. This arrangement provides for threads E being successively linked with each other by picks C^1 and C^2, and with the edging threads by the 1st and 17th picks in the design.

CHAPTER VII

GEOMETRIC DESIGN BASES—WEAVE COMPOUNDS

191. *Weave Units as Design Formulae.*—Many of the standard weaves, as has been shown, have a geometric structure. The basic plan of the plain and of its derivatives is rectangular; that of the twilled crossings, in all their varied forms, consists of parallel lines of intersection details traversing a given width and length of cloth at a pre-determined angle; that of the check, and also of intermixed checkings, is a quadrilateral figure; and that of the different types of transposition weaves is rhomboidal. The "sateen" base is of another order. It consists of a mathematical division of the weave (threads and picks of which the sateen is composed) into a number of equal parallelograms—5, 6, 7, 8, etc., in sateen makes occupying these numbers of shafts. But, in each of these bases, the design plan is purely a weave unit—a simple but complete

scheme of intertexture adapted for producing a distinctive structure of cloth with a specific surface effect. Such weave elements have been considered, firstly, as systems of warp and weft interlacing in fabric building ; and, secondly, in regard to the minute, and in a number of examples, the mosaic forms of pattern they produce.

There is strictly no technique or craft comparable with that of Weaving in the means which it provides for the origination of design details. In the manifold orders in which the threads of warp may be intersected with the shots of weft, there is unlimited scope for acquiring diversity of fabric construction, and diversity of decorative minutiae ; and, in the use of coloured yarns, variously assorted in the warp and weft, each scheme of intersection is capable of giving a special description of textural style. Viewed from this standpoint, the subject of Woven Design—to whatever class of manufacture it relates—affords the widest range for experiment in the elements of loomwork resulting from Weave Principles, and also in their Colour Arrangement and Combination as effected by the crossing of the threads of warp with the shots of weft. When these principles are understood, the more complex phase of textural design, as it exists in weave compounds, is presented for study and analysis. For a fuller exposition of Colour Technique, the reader should consult *Colour in Woven Design* and Chapters XI and XII in *Woollen and Worsted.*

192. *Design Bases.*—In "Design," as a resultant of combining Weave Units, the striped, geometric, and other bases on which the patterns are originated, will be treated of, and the principles of work comprised will be examined relative to each weave unit applied. This method of analysis treats, in the first place, of the basic type ; secondly, of the weave units suitable for combination in a particular form of design ; and, in the third place, of the practices in loom setting, and in the warp and weft orders of colouring adapted to certain weave compounds in making definite styles of pattern.

The following Design Bases will be illustrated and described—

I. Rectangular or Checked Type.
II. Rhomboidal Type.
III. Interlacing Type.
IV. Diamond and Lozenge Types.
V. Compound and Geometric Types.

193. *Rectangular or Checked Base.*—Here the common variety of pattern is that of checking. As the several kinds of weave units are combinable in striped arrangement, they may also be worked on similar principles of combination into designs of a checked character. It follows that should the twilled weaves, of which the specimens A to D (Fig. 113) and E to J (Fig. 114) are the result, be re-arranged and re-ordered in the picks in corresponding sections as the threads have been shown to be regrouped by the healding drafts A′ to D′ (Fig. 113) and E′ to J′, (Fig. 114), they would give checked styles formed of equal rectangular areas as the stripings represent. Such duplicated drafting would cause the striped units to be changed into square and parallelogram units of effect. From this, it is to be understood that line, waved, angled, pointed, and other striped patterns, due to the combination of weave elements, have their complementary forms of pattern in checkings. It will therefore be useful, in treating of this textile design scheme, to explain briefly the technicalities underlying its formation, as a derivative or modification of striped weave compounds, taking lined and other checks as typical of the plan of construction.

The small rectangular effects in Figs. 172, 173, 174, and 175A are apparently acquired by reversing the picks as well as the threads in the weave unit marked in $\boxdot$'s; whereas, in Fig. 113, the order of the intersections in the warp threads are simply inverted for giving the striped characteristics. In checks, as in stripes, different descriptions of crossing may be used, but particularly those of a regular twill and sateen

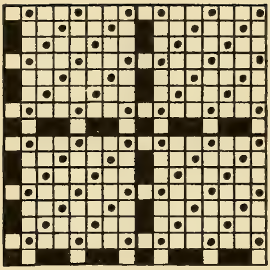


Fig. 172.

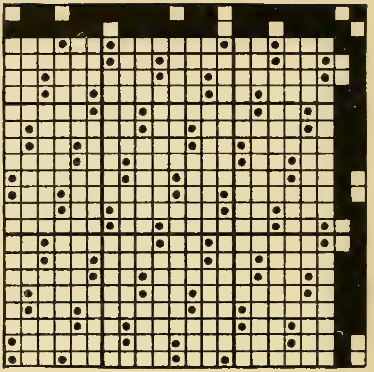


Fig. 173.

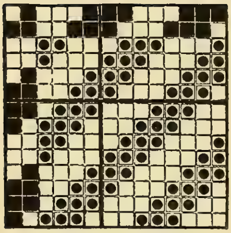


Fig. 174.

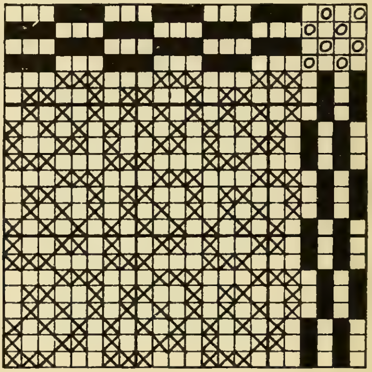


Fig. 175.

Line Checkings in Various Weaves.

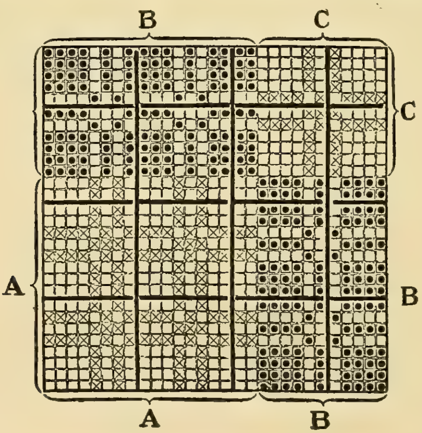


Fig. 175a.—Irregular Mat Check.

variety, which allow of the line details cutting smartly with the details of which the rectangular figures in the pattern are formed.

The line arrangements are modified by reversing two or more threads as in Fig. 173; or, for rendering the cutting

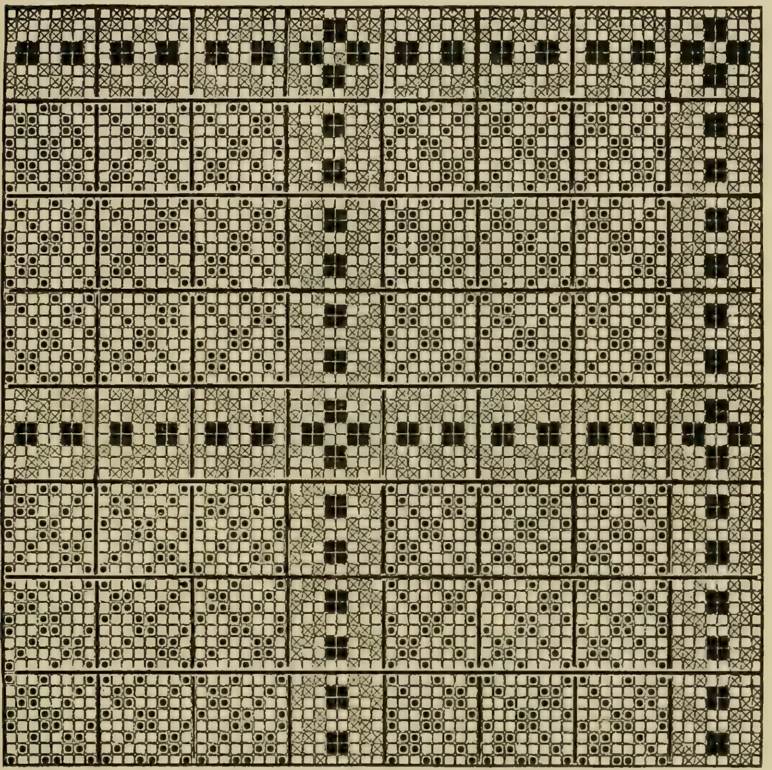


FIG. 176.—DUPLICATED LINE CHECK.

lines the more distinctive feature of the style, they may be developed in a special type of weave as in Figs. 176 and 177, where matted plans are substituted for transposed ends and picks. This latter practice is also suggested in the use of cord and mat weaves for making the intersecting lines in the checkings in Figs. 175 and 175A.

194. *Elaborating Minute Checked Intersection Units.*—By combining two threads, the opposite of each other in interlacing order, on a pre-arranged plan, it was demonstrated in reference to Figs. 116 to 120 how the most elementary type of woven checking is producible. Plans A, B, and C (Fig. 178) are of this structure, but will now be applied in the origination of checked designs containing several weave elements. Each series of intersections in these plans will be assumed as representing a determined number of threads and picks in a compound weave pattern, or the plans will be regarded as fundamental forms of checking. Taking each intersection in Plan

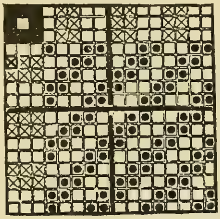


FIG. 177.—CUT-WEAVE CHECK.

178A, as corresponding to 5 ends of warp and 5 shots of weft, it would result in an enlarged type of checking, 30 × 30 on the point paper, that is, as mapped out in Fig. 178D, which, it will be observed, is an extended counterpart of the sectional base in Fig. 178A. Applying the warp sateen to the portion of the design equivalent to the details printed in ☐'s, and the weft sateen to the portions equivalent to the details printed in ■'s, gives a checked pattern (Fig. 178D) consisting of rectangular spaces in sateen makes.

Sketches thus prepared may obviously be made typical of the manner in which specified groups of threads and picks should be combined in producing a repeating checked pattern. Clearly, each of the details in ■'s, ⊡'s, ⊠'s, ◙'s, and ☐'s may also be considered as suggestive of different weave structures. Assuming, for example, that they severally correspond to 8 threads and picks in Plans 178B and C, the result

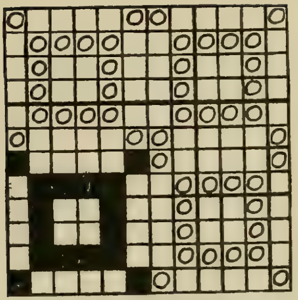


Fig. 178a.

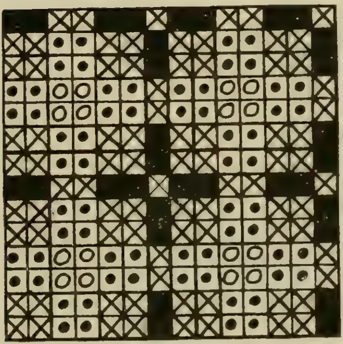


Fig. 178b.

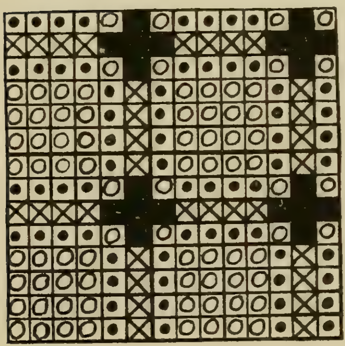


Fig. 178c.

Examples in Check Motives.

would be an enlarged check on point paper of 56 threads and picks. On the sectional parts of the design thus devised,

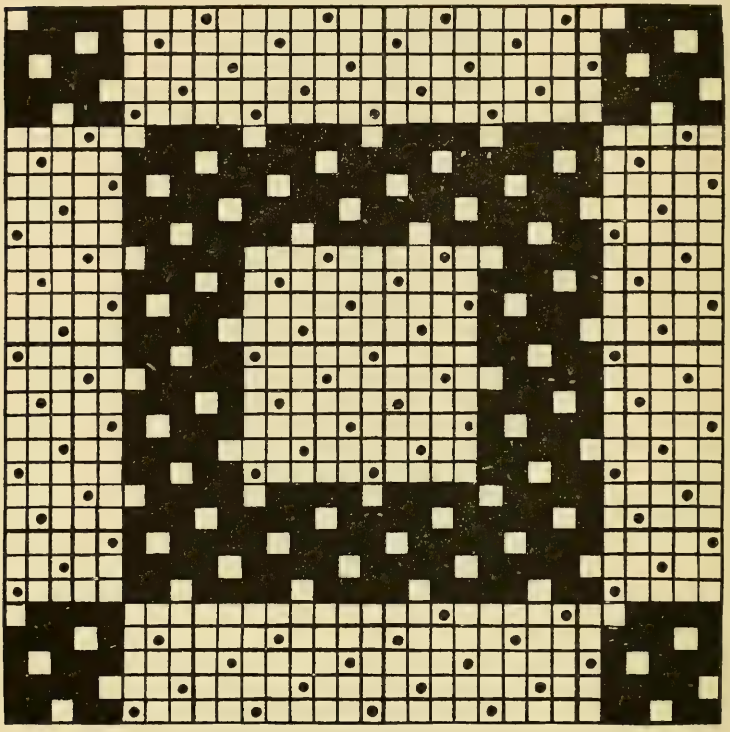


FIG. 178D.—DIAPER CHECK—SATEEN WEAVES.

selected weaves would be run; for instance, in the case of Plan 178B, the outlined check might be treated thus—

Details in $\boxdot$'s = 4-end mat.
,, $\boxed{\circ}$'s = plain make.
,, $\boxtimes$'s = $_{2}^{2}$ twill to the right.
,, $\blacksquare$'s = weft cord.

Or treating Plan 178C, on a similar basis, it would give a

checked combination of the same size (56 × 56), developable in such weaves as the following—

Details in $\boxed{\circ}$'s = mat.
,, $\boxtimes$'s = warp cord.
,, ■'s = weft cord.
,, $\boxdot$'s = $\frac{2}{2}$ twill.

195. *Damask and Diaper Checking.*—While this class of checking finds its specific application to linen and worsted fabrics for decorative use, it is a fundamental basis of design which, in other weaves than the 5-shaft and 8-shaft warp and weft sateens, such as the common twills, plain and leno makes, may be effectively employed in dress fabrics. It is illustrative of the principle of duplicating a definite but strictly limited assortment and plan of intersection details in the production of compound check designs.

The method of combination differs from that dealt with in regard to Figs. 116 to 120, in that the fundamental plan is not a complete scheme of intertexture. Fig. 179 is, as in the checkings weavable on two shafts, the result of the re-arrangement of a given number of intersecting threads—the first three in the example—but it will be seen that the design would not make a fabric structure. If, however, as in the examples described in the previous paragraph, each intersection were taken as a 4-thread and 4-pick unit, and the plain weave were applied to the blank sections, and a mat weave to the sections in ■'s, the design would repeat on 276 ends and picks, and the ground would be in plain and the checking features in mat.

196. *Converting Twilled Weaves into Diamond and Waved Checked Types.*—It was indicated in reference to Fig. 158, that by drafting the picks of weft as the threads of warp, diamond figures would be formable in Stripe B. The application of this practice in drafting is shown in Figs. 180 and 181, where, by using, in the first pattern, a $\frac{3}{1}$ twill, and, in the second, an 8-shaft plan, the rectangular sections in twill, waved lines, and in diamond-shaped details, have been constructed. Selecting twilled units, varied in the intersection lines, and retaining the

basis of construction as a standard factor, patterns, more or less decorative in style and structure, are obtainable in different classes of dress fabrics. Weaves suitable for this purpose

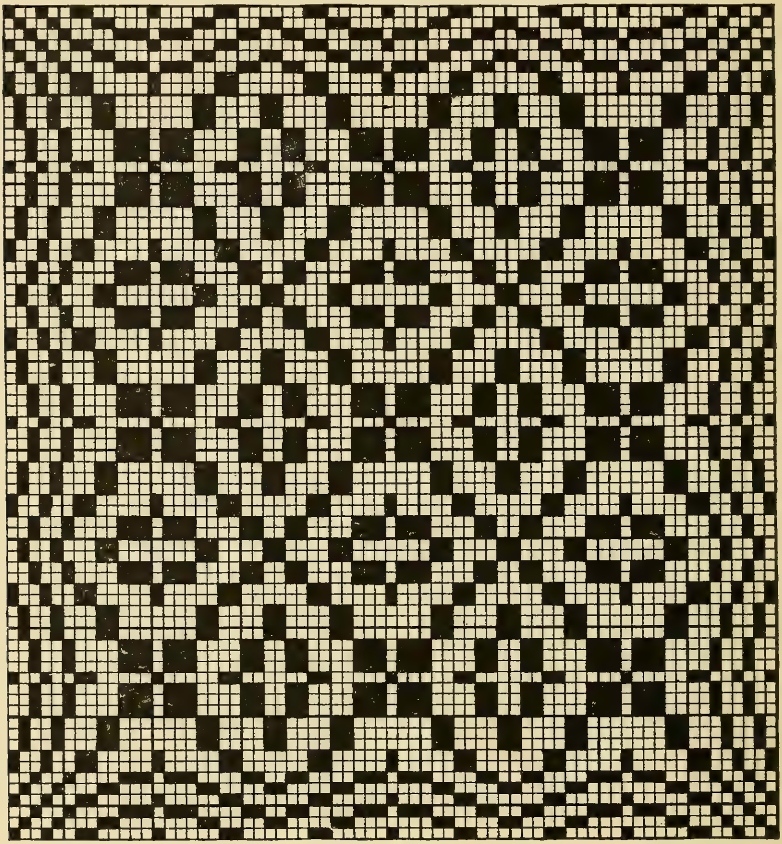


FIG. 179.—DRAFTED DIAPER CHECK.

include those seen at A, Fig. 102; B, Fig. 103; C, Fig. 104; and twills on 9, 10, or 12 shafts arranged—

$$\frac{3\quad 1\quad 1}{2\quad 1\quad 1},\ \frac{3\quad 1\quad 1}{3\quad 1\quad 1},\ \frac{3\quad 1\quad 3}{2\quad 2\quad 1},\text{ and }\frac{3\quad 1\quad 1}{3\quad 2\quad 1}.\ \begin{matrix}=\text{Warp}\\=\text{Weft}\end{matrix}\Big\}\begin{matrix}\text{inter-}\\\text{sections}\end{matrix}$$

It will be seen that the idea is that of using the twilled crossing

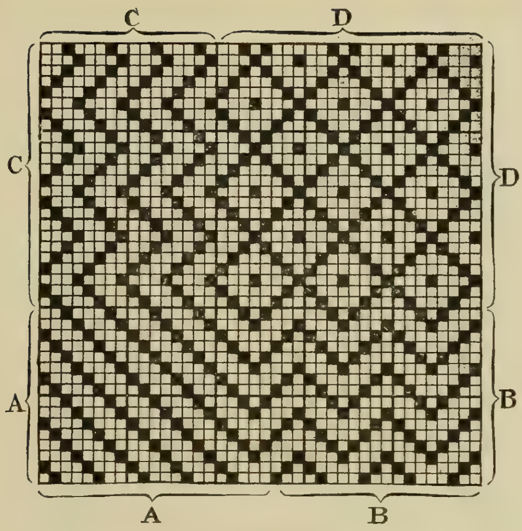


Fig. 180.

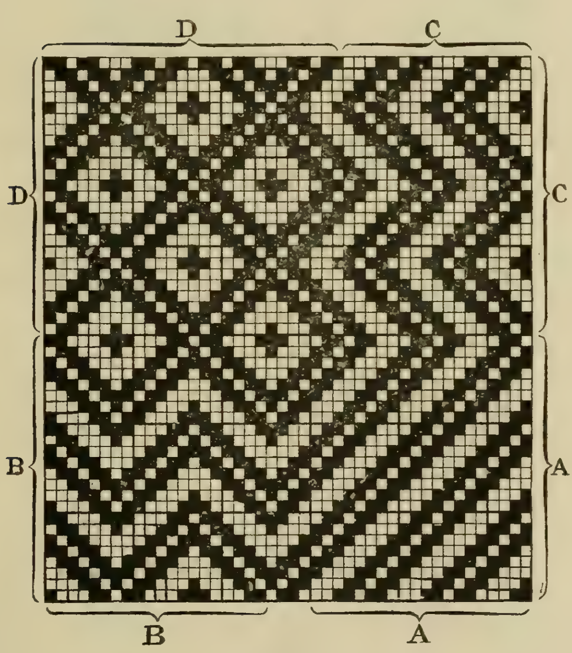


Fig. 181.

Drafted Twill Checks.

for section A (Figs. 180 and 181), and of running it alternately to the right and to the left in the *threads* for section B, and in the *picks* for section C, and of reversing the twill in both the *threads* and *picks* for section D.

197. *Waved and Diamond Checks with a Plain Ground.*—Diamond, waved and spotted checkings, with the ground of the texture woven in plain, are a modified description of this principle of design. The blouse specimen in Fig. 182 is illustrative of this form of combination. Considering the design as a weave compound, that is detached from the colour scheme by which it is neatly enhanced, it comprises—

(1) The simple form of checking in sections A and A′, centrally ornamented with a series of spottings.

(2) The weave units produced, where the texture is woven 6 picks of cotton and 4 picks of silk, or the detailed features in section B.

(3) The corner diamond figures which, in 2-and-2 colouring produce, in the drafting plan, the details seen at D and D^1.

(4) The waved features along section C due to the design for the diamond spottings in A, and to the healding draft for section B.

In designing checked styles of this character, the detail units are primarily selected and planned on a suitable base. This done, the system of drafting is formulated, and ranges of designs are originated workable in the selected healding draft.

198. *Various Checked Forms with a Plain Ground.*—Several of the designs examined have been made from one weave by transposing its thread and pick units ; but, in the intersecting lines for specimen Fig. 182, a waved element is combined with the plain crossing, and the resultant effects converted by drafting, into a diamond check. Other typical examples, with plain as an ingredient, are given in Figs. 183 to 187, in which the plain make lends stability and evenness to the texture, while the mat, cord, and fancy weaves impart the design effects. To bring out the structure of each plan in this form of check, certain groupings of tinted yarn are essential. These

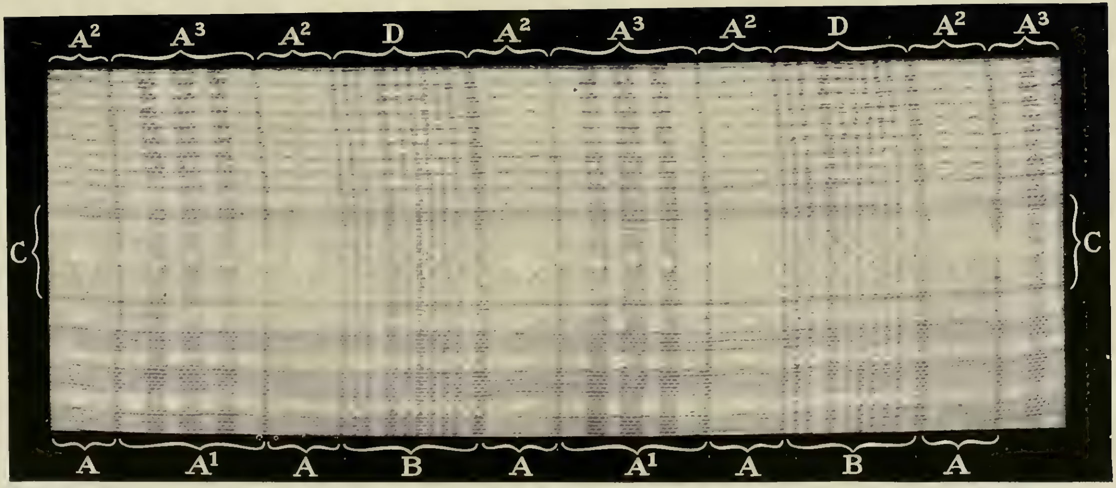


FIG. 182. FANCY BLOUSE CHECKING—DRAFTED STYLE.

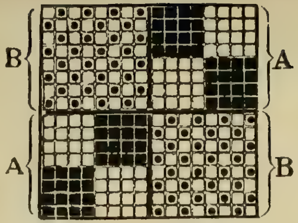


Fig. 183.

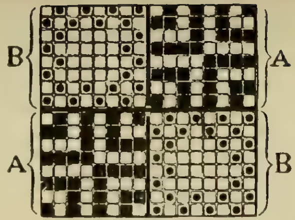


Fig. 184.

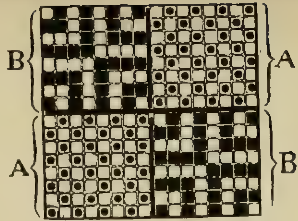


Fig. 185.

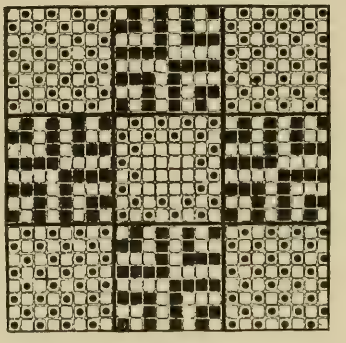


Fig. 186.

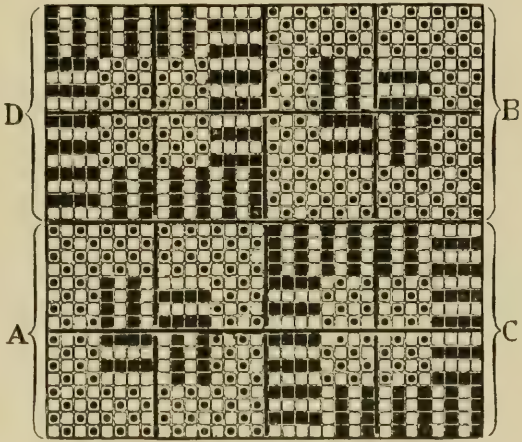


Fig. 187.

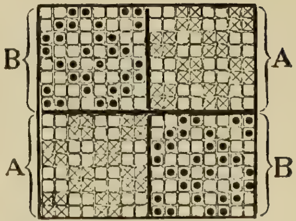


Fig. 188.

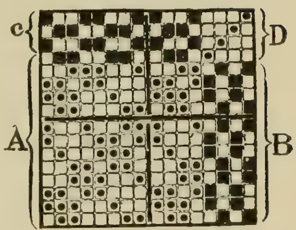


Fig. 189.

Examples in Checking.

groupings may suitably tally with the method of weave combination, as, for example, in—

Figs. 183 and 184,	Coloured	8-and-8 in both	Warp and	Weft.
Fig. 185,	,,	1-and 1	,,	,,
Fig. 186,	,,	8-8-and-8	,,	,,
Fig. 187,	,,	1-and-1 or 4-8-and-4	,,	,,

applying two sets of coloured threads in each warping and wefting arrangement. Designs of this class are also woven in one colour of yarn in cotton, linen, silk, and worsted textures.

It should be pointed out that a change in one of the weave units in the pattern, alters the textural effects, though the checking features remain constant. Figs. 183, 184, and 185 are of the simplest form of pattern, the sectional checkings being composed of equal numbers of threads and picks. In the first of these examples plain is combined with mat, in the second plain with warp effects and checked repp; and, in the third, squares of plain with squares of checked repp. Fig. 186 is a compound of Plans 184 and 185, resulting in larger and lesser squares of detail, in plain repp and warp effects respectively. The basis of the counter-change check is illustrated in Fig. 187, in which section A is transposed at B, and C at D, with the plain elements in A and B produced in warp and weft repp in C and D.

199. *Developing a Constant Checked Type.*—Each of the basic forms of checking is adapted for development in a variety of weave units, and in different sizes of pattern. The common checks, with the two types of effect transposed, are applied to the several classes of dress manufactures, and are formed in many types of crossings. For example, in the 8-and-8 check in Fig. 188, parts A consist of 2-and-2 mat and parts B of $\frac{2}{2}$ twill reversed, with parts A and B transposed on the dice principle. Regular, as well as modified mats on 6 and 8 threads, or weaves composed of mat and plain, are treated on this system of plan-making, and combined with 6-shaft and 8-shaft twills.

Another elementary order of checking, developed in quite a number of the standard weaves, is that in which larger and

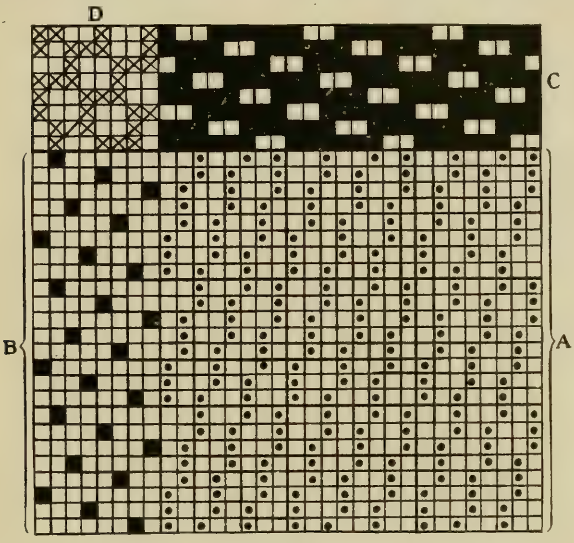


Fig. 190.

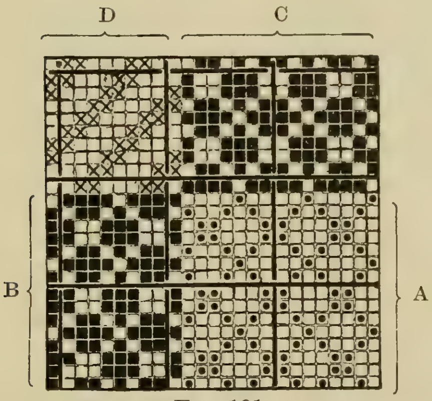


Fig. 191.

Checking in Three-weave Units.

smaller squares interchange with each other, and with intermediate parallelograms in a third variety of textural detail. Figs. 189, 190, and 191 are given in illustration of this basis,

and also of the weaves usable, and of the methods of combining them. The first design consists of four crossings, namely, a 12-shaft small diagonal, warp and weft cords, and the $\frac{3}{1}$ twill; the second of 8-shaft fine warp twill, sateen, weft-face twill, and twilled mat; and the third, of irregular hopsack, $\frac{3}{3}$ twill, and of the hopsack reversed. While, on the preceding base, two or three weaves were selected with different plans for sections A or B respectively, in Figs. 189 to 191 the larger sections A are usually formed in one weave, sections B and C in one or two weaves, and section D in distinct type of weave, The object, in constructing the designs, is to combine weaves which accentuate each other and define the sectional parts of the style, and which also yield a sound description of fabric.

200. *Cord and Repp Weave Checking.*—Cords and repp plans are employed in the origination of simple and intermingled checked designs. Their use in the former was noted in describing this class of plain-weave derivatives. Irregular cords, such as those observed in Fig. 192, admit of either two *warp* or two *weft* crossings being transposed as in parts A and B of this example, and marked in ⊡'s, ■'s, ⊠'s, and ▩'s. Colour practice is important in the weaving of these patterns. Though constructed on a check base, they may, by adopting certain systems of looming, be changed in character. Warping and wefting (Fig. 192) as below—

One thread	or pick	of	grey white	for 6
,,	,,	,,	white grey	,,
,,	,,	,,	grey white	,,

would give an ordinary checked formation, but should the order of the colouring be changed throughout the warping and wefting to 1 grey and 1 white, similar effects to those seen on point paper would be also observed in the woven production. This arises from the fact that the grouping of the shades would tally with the weave structures, bringing out

their distinctive details. It would, therefore, cause the dotted intersections in part A to form transverse lines of white alternating with *transverse* lines of grey, and exactly set across correspondingly coloured lines in the sections marked in ■'s; whereas, in section B, equivalent but *vertical* lines in grey and

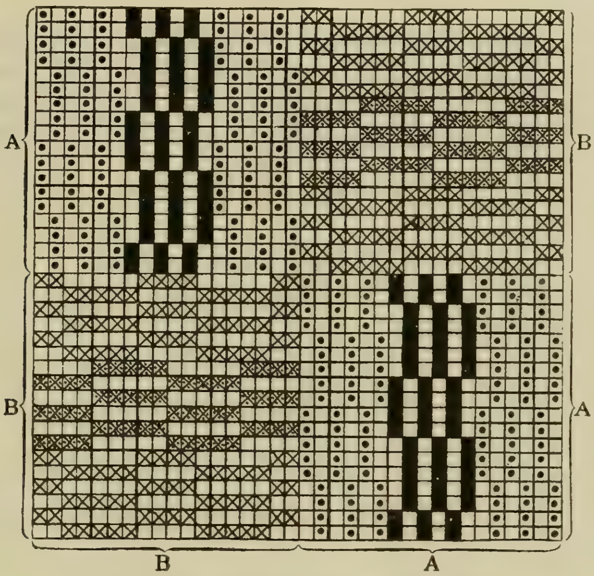


FIG. 192.—REPP OR CORD CHECK.

white would be relatively arranged in the details in ⊠'s and in ⊠'s, as in parts A of the pattern.

This method of colouring is also applied to checks in which twilled and ribbed waved plans are employed, as it adds to the diversity of the textural contrasts in a given design. Thus Fig. 193 would, in piece-dyed goods, result in a well pronounced type of checked style; but, if arranged in the warp one thread of tone 1 and one thread of tone 2, and wefted in tone 3, the waved lines would be expressed successively in tones 1 and 2; the weft cords, in parts B and C, in tone 3; and the small squares of effect, in D, in the three tones intermingled. To further show the utility of the colour

scheme in cord and weave combinations, Fig. 194 may be assumed to be tinted as follows—

Warp—1 thread of light red, and 1 thread of toned red.
Weft—1 pick of light greenish-blue, and 1 pick of toned greenish-blue.

The design is made up of warp cord, in ⊠'s; weft cord, in

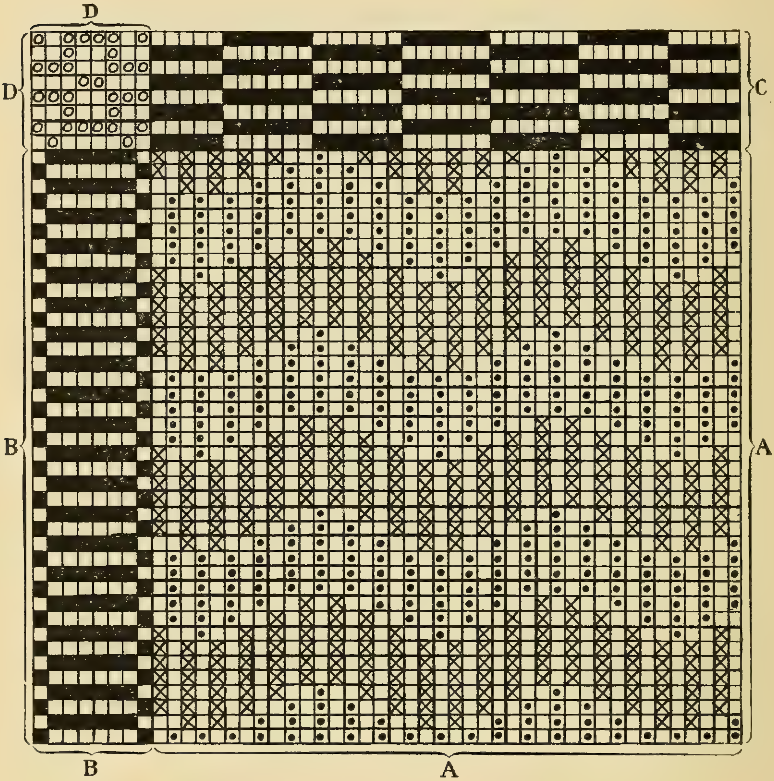


FIG. 193.—WAVED CORD CHECK.

⊡'s; and of a checked warp and weft cord, in ■'s. The first would, in this order of colouring, develop warp lines in tinted and toned red, the second weft lines in tinted and toned greenish-blue, and the third, a melange spotting in the two tints and two tones of colouring. Seeing that in weaves of a repp structure, the warp plans conceal the weft interlacings,

and the weft plans the warp interlacings, they enable the repp details, either warp or weft, to be developed clearly in two shades, and yet the pattern scheme—checked or figured—to be distinctly brought out in the cloth.

201. *Star Checks.*—Ordinary star checkings are producible by colour arrangement in the elementary weaves, such as in the 2-and-2 order of warping and wefting in the plain weave; in the 4-and-4 colouring in the 2-and-2 mat; and 6-and-6 colouring in the angled 6-end twill. Another species of star checking, and that now comprised, is derived from types of woven colour effect, but the base is extended and two or more weave units are combined.

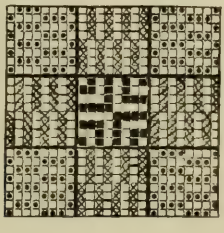


FIG. 194.—CHECK IN WARP AND WEFT CORD WEAVES.

This description of checking will be treated of by showing that the different types of geometric form may be arranged on a rectangular plan. Such form types may be in juxtaposition in the pattern, or they may be detached from each other, and with the intermediate ground spaces filled in with the selected weave units. Fig. 195 is designed on the latter basis, having a 16-shaft weft twilled cord in the star features, and a 12-shaft warp twill in the sections marked in ⊡'s. Increasing the area of the ground between the figures tends to subdue the checked quality of the pattern, but this may be obviated by altering the base utilised on some such principle as shown in Fig. 196, section A of which shows the star grouping in Fig. 195. Considering each intersection in this modified

base as equal to 8 × 8, the extended design would be on 96 × 96, and the stars marked in ■'s would be woven in a

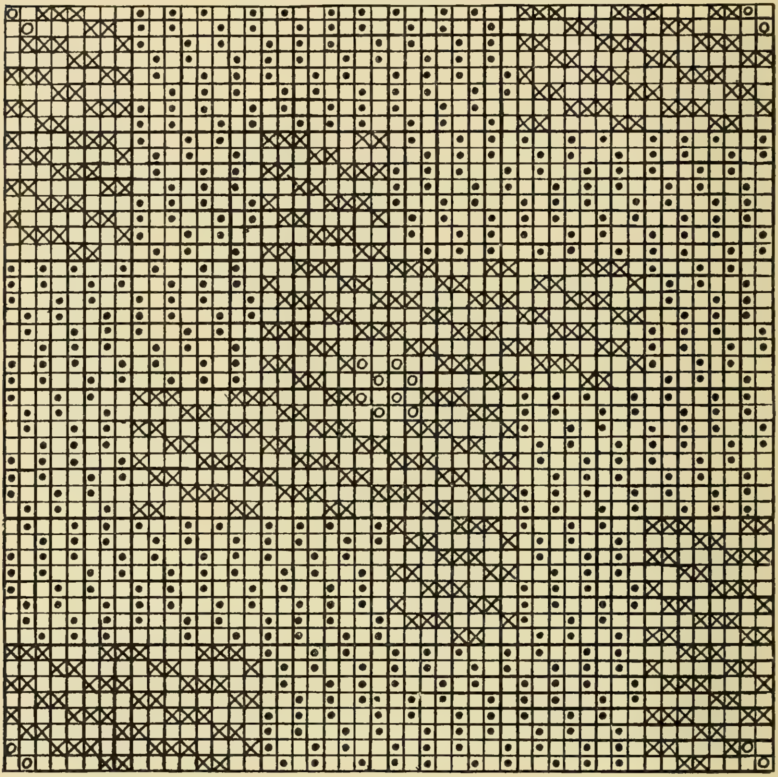


FIG. 195.—STAR CHECK—CORKSCREW WEAVES.

different plan from those marked in ☒'s, so that the over-checking lines would appear in the pattern. To make this point clear, two practices in working out this base are as follows—

PRACTICE I

Effects in Grey in Fig. 196 = Cassimere.
,, ☒'s ,, = Mayo.
,, ■'s ,, = Warp cord in the four centre interlacings and weft cord in the four points of the star.

PRACTICE II

Effects in Grey in Fig. 197 = Plain.
,, ⊠'s ,, = Cassimere.
,, ■'s ,, = $\frac{3}{1}$ twill.

In the first of these weave arrangements, the ground would be cassimere, with the two series of stars, in ⊠'s and in ■'s, in Fig. 196, in mayo and warp and weft cord ; and in the second

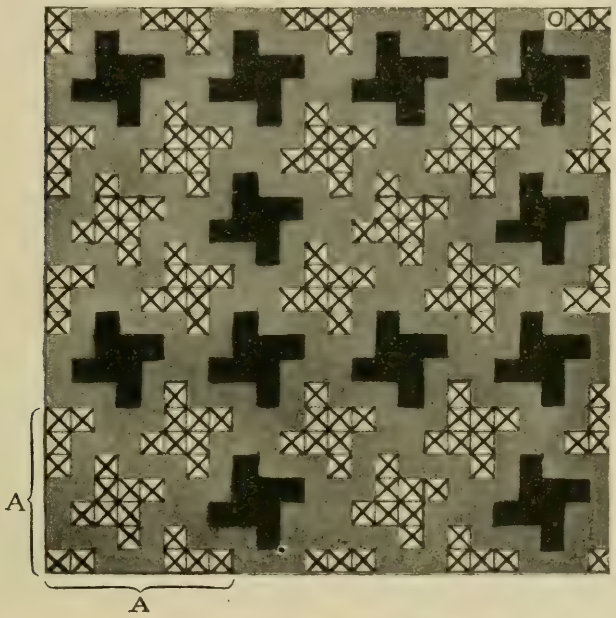


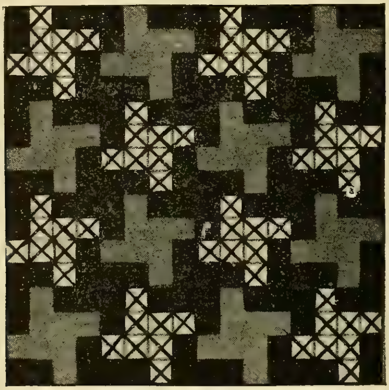
FIG. 196.—STAR CHECKINGS.

weave grouping, for a lighter build of fabric, the ground would be in plain, the stars in ⊠'s in cassimere, and the stars in ■'s in warp twill.

With a view of producing the checking elements in contrast with each other, the plan of arrangement followed is that seen in Fig. 197. Using this as the basis of a design on 64 × 64, it would be suitable for development in the plain make and a 4-shaft weave ; in 4 and 8-shaft crossings ; or in three 8-shaft weaves, such as the details in ■'s in the 8-shaft warp sateen,

the details in ☒'s in plan F, and the details in grey in Plan J, Fig. 104.

202. *Checked Patterns in Multi-weave Compounds.*—Checked patterns are, in effectiveness and in symmetry of composition, the result of textural contrasts. In the smaller and simpler, as in the broader and more complex design structures, the tone and quality of the several weave units, of which the checking lines and other features of the patterns consist, impart style



197.—Star Checkings.

definition and originality. Combining, as in Figs. 183 and 185, plain and mat and plain and inverted cord weaves, produces minute squares then two textures in the same fabric. All checked cloths are, therefore, composed of alternating rectangular portions of distinct textures, woven in two or more crossings, or woven in transposed weave plans. Elaborating the weave types employed, and the geometric order in which they are assorted one with the other, may be practised to an indefinite degree, but the process of elaboration carried out must be in absolute accord with the form of design intended, and with the manufacture of a wearable cloth.

Three illustrations in multi-weave compounds of a special order, yet in which the standard forms of check arrangement obtain, and given at Figs. 198, 199, and 200. Fig. 198 is

constructed on the plan of grouping rectangular spaces of effect of equal proportions, namely, 32 × 32 ends and picks for sections A, B, C, and D; that of Fig. 199 of combining larger and lesser areas of detail and of intermediate oblong figures

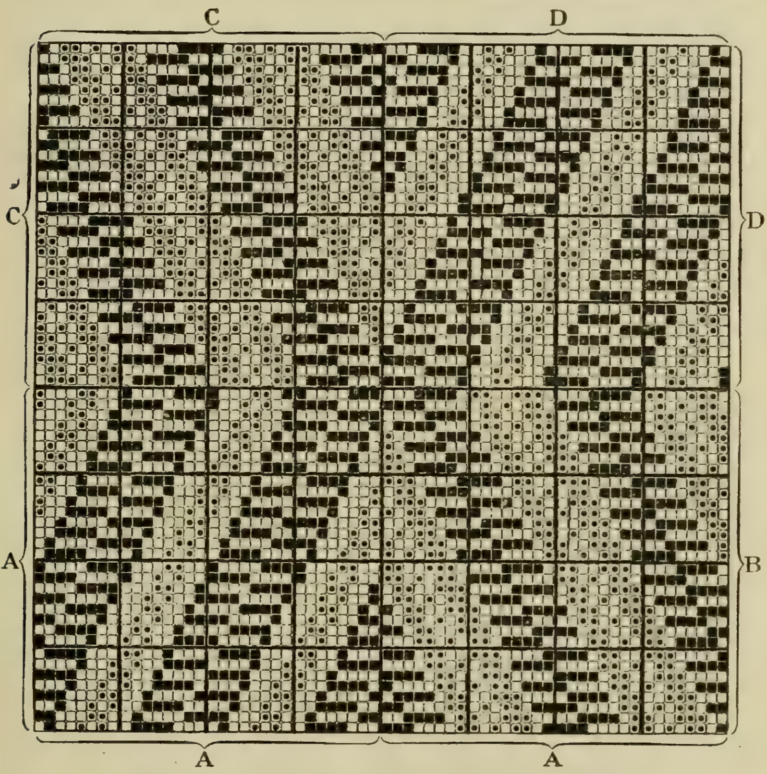


FIG. 198.—CHECKING IN DIAGONAL WEAVES.

in a third weave; and that of Fig. 200 of forming squares of open weave structures, with a special textural unit for developing the divisional features.

203. *Development of Diamond Outlines in Checking.*—Each design is distinctive in type and in structural elements. Examining Fig. 198, it will be seen that a 16-shaft diagonal has been selected for part A and inverted for parts B, C, and D on the dice scheme of checking. The diagonal weave in this

illustration, gives a lozenge form to the checked composition. Had the details in ■'s been of an ordinary twilled kind, this characteristic would not have been acquired. When the weaves are of the repp description, and run in a twill, the

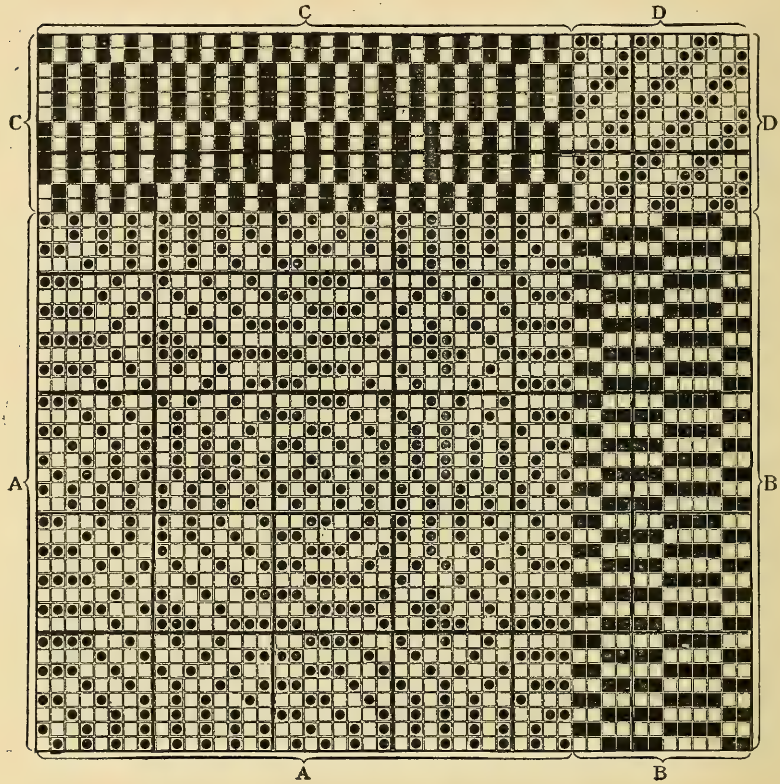


FIG. 199.—FANCY CHECKING IN CORD AND TWILL WEAVES.

process of reversing them tends to show a waved line; hence the duplicated transposition of such effects produce, as seen in the example, either a diamond or a lozenge figure. This class of compound check and lozenge basis of design is also obtainable in diagonal plans in which the order of transposition results in corresponding lines of effect in the series of warp as in the series of weft intersections. Included in the plans given

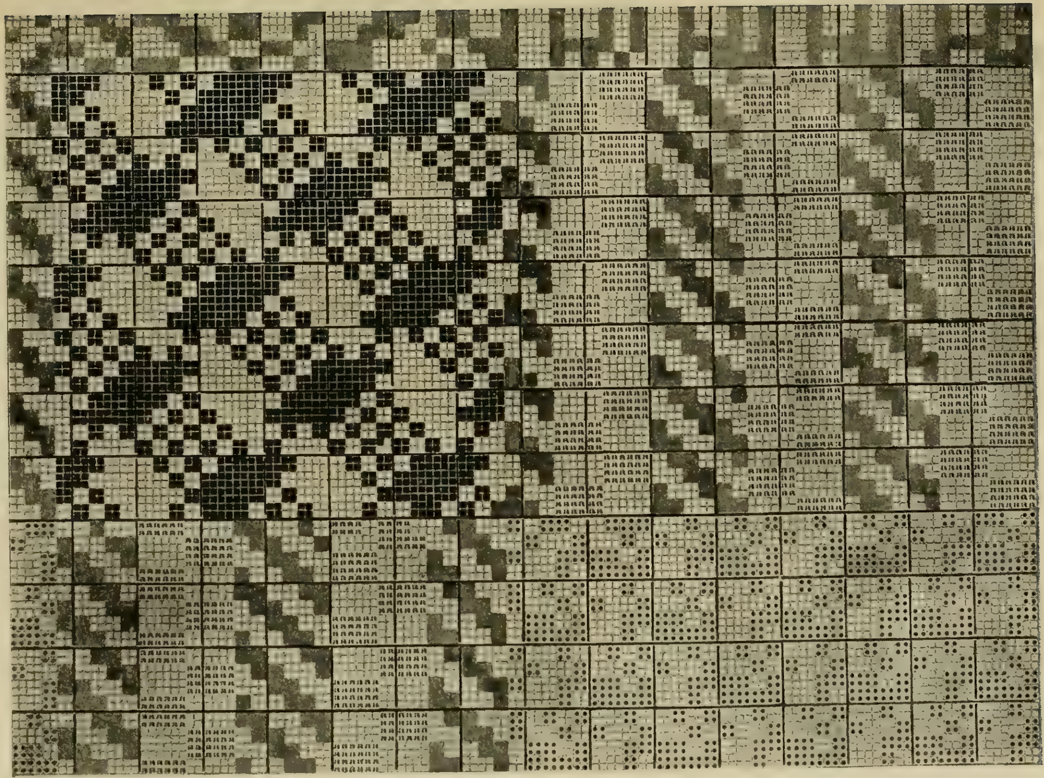


FIG. 200.—CHECKING IN OPEN-WEAVE STRUCTURES. (*Section only.*)

in the standard shaft-mountings, the following may be selected for the construction of similar varieties of pattern to that reproduced at Fig. 198—

Twilled Type.	Plans.	Sectional parts in which the designs should be made.	Heddle Mountings in which the designs are weavable.
7-shaft	D & E, Fig. 103	14 × 14 21 × 21, etc.	14 shafts.
8-shaft	C^2 & D^2 „ 77	16 × 16, 24 × 24 „	16 „
10-shaft	J & N „ 106	20 × 20, 30 × 30 „	20 „
12-shaft	H & O „ 108	24 × 24, 36 × 36 „	24 „

204. *Weaves Applicable in Modifying Diamond Outlines.*—For developing the checked outline, but for modifying the diamond features observed in the repeats of the design in the fabric in Fig. 198, such plans as are specified below may be employed—

Twilled Type.	Plans.	Sectional parts in which the designs should be made.	Heddle Mountings in which the designs are weavable.
6-shaft	N, O & P, Fig. 102	12 × 12, 18 × 18, etc.	12 shafts.
7-shaft	A, B, C & D „ 103	14 × 14, 21 × 21 „	14 „
8-shaft	B, C & F „ 104	16 × 16, 24 × 24 „	16 „
9-shaft	A, B & C „ 105	18 × 18, 27 × 27 „	18 „
10-shaft	H & L „ 106	20 × 20, 30 × 30 „	20 „
12-shaft	M & P „ 108	24 × 24, 36 × 36 „	24 „

These weaves are indicative of the varieties of crossings usable, but are not to be taken as covering the many kinds of twills—elongated in the warp or weft according to the description of pattern intended—and other types of fancy twills running at an angle of 45°, which are, in addition, adapted for this style of checking. When, however, more decorative textural effects are desired, and in fine fabrics, specially-constructed weaves are applied. Should, in these instances, the details of the crossings, as in the diagonal make in Fig. 198, give prominence to both the warp and weft intersections (see the warp and weft transposed elements in sections A and B) it is essential that the weft, as well as the warp yarn, should be

of a suitable count and quality for expressing such effects clearly and smartly in the woven cloth.

205. *Special Weave Structures and Checked Styles.*—Fig. 199 belongs to another category of checking as regards weave composition. Here the system of inverting and transposing given plans of interlacing is not practised either in parts A or D; and in parts B and C one weave is an irregular warp, and the other an irregular weft cord. The textural plan in part A is of a varied formation, having some resemblance, in the interlacing details, to the filament contexture of a spider's web. That this has been rendered feasible is due to the practice in combining and planning the warp and weft intersections, which are formed in fine twill, weft elements, plain weave, and in warp and weft repp systematically diversified in length of float. Section A of the check is a complete and effective blouse plan either in piece-dyed fabrics, or in variously-coloured fancies. It is shown here as the principal weave scheme of a checked pattern on 48 threads and picks, and in combination with weaves that develop its definite structural features. Plans B and C result in neat areas of warp and weft repp, while the 12 ends and picks of twill form a corner feature which also harmonizes with and accentuates the details in parts A, B, and C; and, at the same time, gives a special tone to the design composition.

206. *Open Weave Structures and Checked Compounds.*—Fig. 200 is typical of the technical and weaving ingenuity which may be displayed in the construction of checked patterns in which the plans combined are open in structure. In the example the method of assorting the weaves, as well as the practice, in selecting the types of weave employed are suggestive. It is, in such styles, a question of producing new and effective textural contrasts and of acquiring an appropriate build of fabric, with the weaves so grouped as to give a pronounced checking. There are, in Fig. 200, first, the warp and weft floated features marked in ■'s; second, the intersection plans marked in ⊡'s; third, the special twilled lines

in grey; and fourth, the elongated mat or hopsack details printed in ☐'s. The effects of each plan are quite visible in the photographic reproduction at Fig. 200A. The intersection value of each weave unit is here observed, but the details, due to the respective crossings, are better defined in the woven specimen than in the illustration. Designs of this originality in weave combination, and also those described

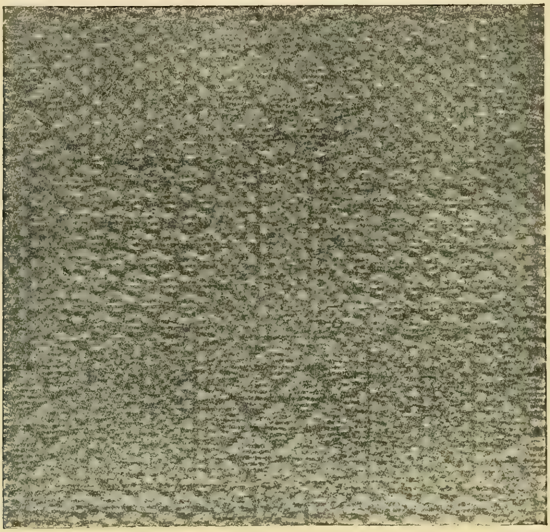


FIG. 200A.—TEXTURAL EFFECT OF THE DESIGN IN FIG. 200.

under Figs. 198 and 199, are, in the loom-setting practice, adaptable to silk, cotton, and linen manufactures, and likewise to union dress cloths. This open-make pattern is, for example, weavable in a silk and linen union, using 2/60's linen warp, crossed with 20's silk, and having approximately 102 threads and 96 picks per inch in the loom.

207. *Rhomboidal Base.*—The term "rhomboidal" has been applied: (1) to twilled patterns in which the twill lines are worked into parallelogram forms, with the figures in a transposed relation; and (2) to compound and fancy twilled

features blended into rectangular figures, set across each other in the repetition of the design. But the term is, in a sense, descriptive of all types of pattern consisting of such geometric figuring, should the figured forms be symmetrically inverted and disposed at right angles to each other in the composition of the style. The first variety was treated of in dealing with the principles in originating weaves on a transposition base—the plans, illustrated at Figs 95, A, B, etc., being suggestive of the rhomboidal base as applied in weave construction. The scheme there presented is adapted to extended and decorative treatment with the weave elements selected, and with variations in the number of threads and picks the designs occupy.

Fig. 201 is a design type formulated on this basis. First the broad lines in weft twill marked in ■'s are exactly transposed, starting at the points *a* and *a′* on the 1st pick and thread, and on the 25th pick and 48th thread of the example. Next there have been added, on each side of these details, the lines in plain in ⧇'s, and also of the varied weave features in ⊡'s; followed by serially transposing the several groups of pattern elements worked out in relation to the initial lines *a*, and in corresponding sequence and relation to the initial line *b*.

Such a plan of design gives geometric forms of a different quality and structure with the movement of the twilled type employed. Using, as in Fig. 202, a twill moving 2 picks for 1 thread, divides the area of the design into the parallelograms A and B, intersecting each other at right angles, the intermediate spaces being of a lozenge shape, and filled in with $\frac{2}{2}$ twill checked. In the sketch at Fig. 203, another principle of arrangement is shown with figures C and D and E and F formed into stripes, but C set across F, and D across E. One portion of this sketch transferred on to point paper, is seen at Fig. 203A developed in 4-shaft twills, which twills are sufficiently dissimilar from each other in effect, to impart a suitable degree of emphasis to the different sections of the pattern.

Should, for instance, the style be woven in a light shade of warp and a medium tone of weft, the respective parts of the figure would be clearly developed in the fabric, for those in ■'s

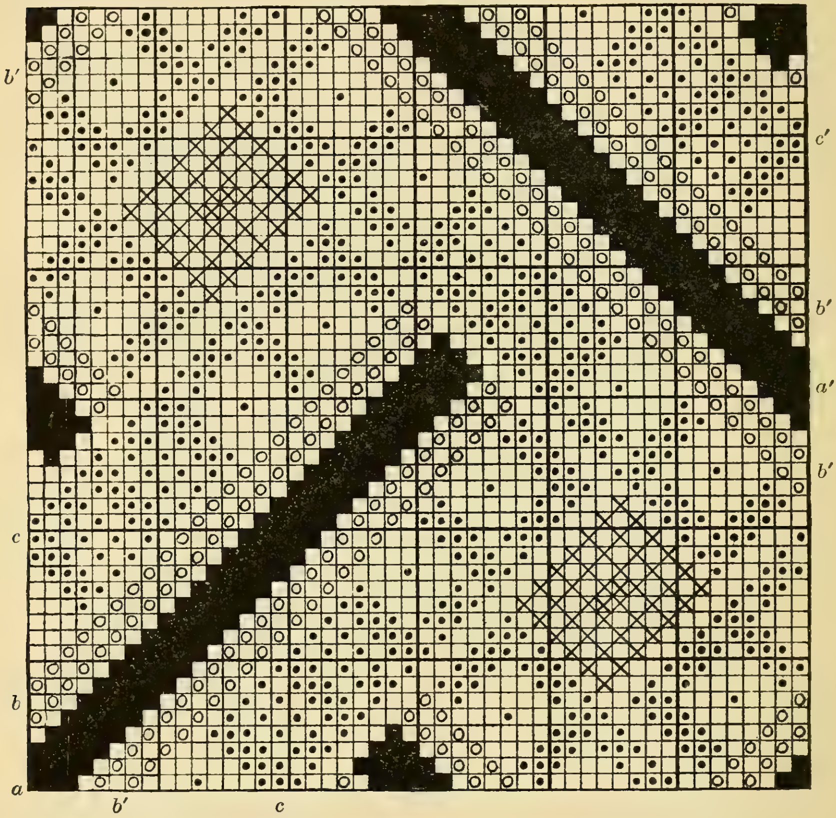


Fig. 201.—Rhomboidal Base.

would be in the medium tone, those in ⊡'s in the light tone, and those in ⊠'s in the two tones equally blended.

208. *Rhomboidal and Transposition Basis.*—The rhomboidal is to be distinguished from the pure transposition base of design. The latter generally consists in selecting a simple or decorative type, and systematically inverting its integral

parts, but the former comprises also the construction of the figure by the class of weave structures combined, and the regular transposition of these in completing the pattern.

The rhomboidal character in Fig. 203 is, however, elemental in the plan of figuring. Here, and also in Fig. 204, the basical scheme is rhomboidal, in so far as quadrilateral figures are

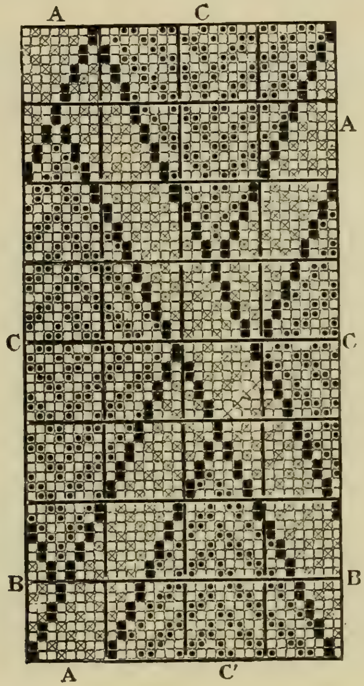


FIG. 202.—ELONGATED RHOMBOIDAL PATTERN.

employed whose angles are not right angles. The different forms in the latter—woven in $\frac{3}{1}$ twill in the ground—are determined by the lines in flushes of weft yarn, consisting of step twill and of sateen. They show the applicability of the rhomboidal principle of pattern design to other than twilled units, and arranged as in Fig. 95 A to E, and also as in Figs. 201 and 202. The types of form blending, derived from the modification of the Grecian key pattern, may also be utilized by

producing the divisional lines in warp or in weft crossings, and by filling in the intermediate and geometric areas with plans of the reverse construction, or with plans of a distinctive character. The demarcation features A, A and B, B (Fig. 204) are weavable in 2, 3, 4, and 5 threads and picks, according to the value it is intended they should have in the definition of the style.

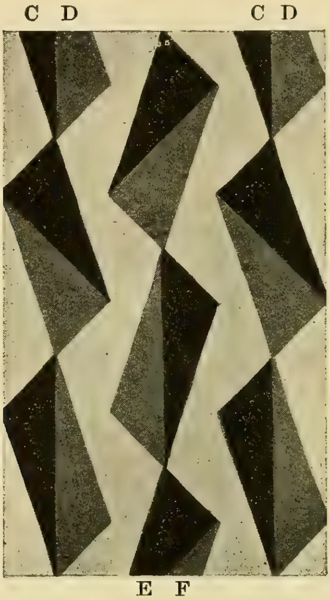


FIG. 203.—MODIFIED RHOMBOIDAL BASE.

209. *Transposed Base in a Single and Compound Build of Fabric.*—Both these examples (Figs. 203 and 204) differ from that of the ordinary transposition base which is illustrated in Fig. 205, a design composed of the regular figure at A, transposed in every detail at B, and texturally developed by weaving the cloth in a 2-ply structure in the figuring, and in a single structure in the ground.

In sections A and B, every third thread in the warp, and every third pick in the weft, floats on the face of the cloth.

making plain intersections of an open order, but securely knitted into the cloth foundation. These threads, by reason of their separatedness, produce a kind of leno or gauze effect on a firm woven surface; but as the cloth to which they are stitched is quite firm in build, there is not here that thinness of structure which characterizes the leno fabric. Strictly, the

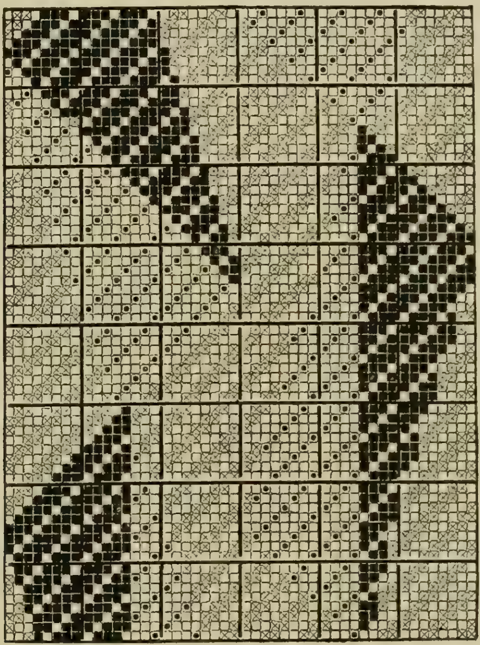


FIG. 203A.

figured sections, in this class of design, consist of two weaves, working independently of each other, and each forming a special texture; thus, while the threads and picks *f* give the canvas effect, the cloth proper is formed by the threads and picks *g*. In the ground of the pattern, these two sets of threads are amalgamated in the single twilled weave. In order to clearly develop the pattern style, the threads *f* should be of a different quality from threads *g*, as for example 2/60's

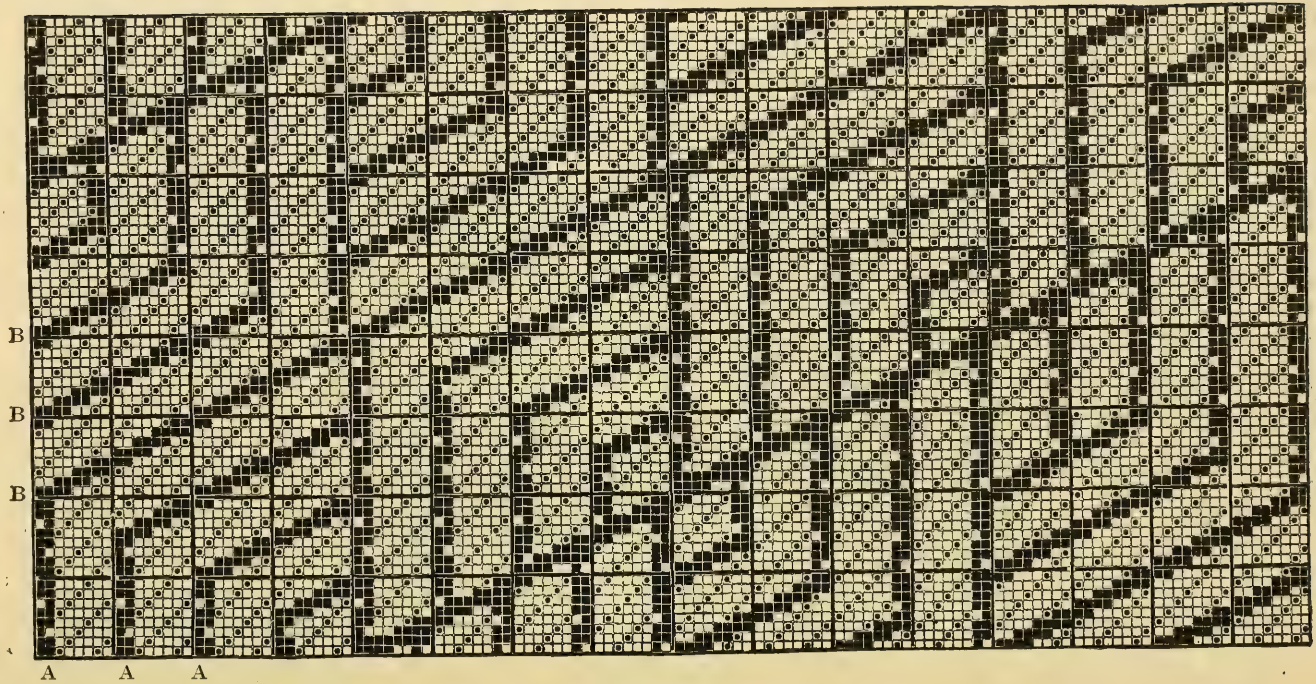


FIG. 204.—EXTENDED RHOMBOIDAL TYPE.

cotton warp for the latter, and either 2/30's mercerised cotton or silk for the former. The figuring threads or picks spot or check the single weave ground of the fabric in addition to developing the design features.

210. *Interlacing Figuring.*—One of the basic geometric

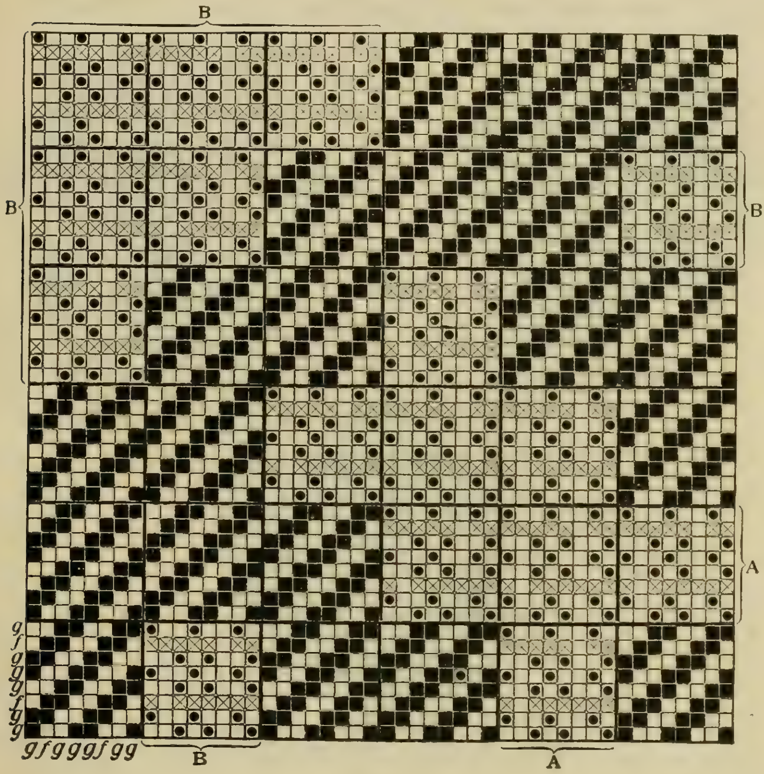


FIG. 205.
TRANSPOSED BASE: SINGLE AND COMPOUND WEAVE STRUCTURES.

pattern forms is that synonymous of the masonic craft. It is obtained by inverting and intercrossing triangular figures, which, whether executed in straight or curved lines (concave or convex), are the co-efficient of each other. As such, they are indicative of unity and of perfect co-ordination. Each of these form units (Figs. 206, A, B, and C) may be translated

into a woven result by developing one figure in warp and its complementary figure in weft effect, and by weaving the ground of the texture in a third crossing of a suitable construction for giving equal emphasis to the figures sketched in toned and in dark grey.

The structural plan of interlacing decorative forms here

FIG. 206A.

FIG. 206B.

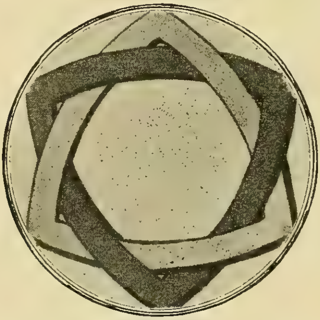


FIG. 206C.
INTERSECTING GEOMETRIC FORMS.

illustrated, is, in textile design, utilized in producing patterns on the diamond, the diagonal and figured bases. The diamond composition is observed in the simple example in Fig. 207. It comprises two sets of interlacing lines in double plain makes developed on a single-plain make ground. Colouring the pattern 1 thread of tinted yarn and 1 thread of toned yarn in the warping and in the wefting would give a textural ground in hair-line effects, on which the interlacing details

printed in ⊡'s would be in the tinted colour, and those printed in ■'s in the toned colour. The fundamental principle here typified is that of the line effect A passing over the line effect B, followed by the line B traversing over A. The effects enclosed in these intersecting lines are woven at A′, in the tinted threads; and at B′ in the toned threads, and form central spottings in the two colours on the hair-line striping. Enlarging the base, and combining three weave

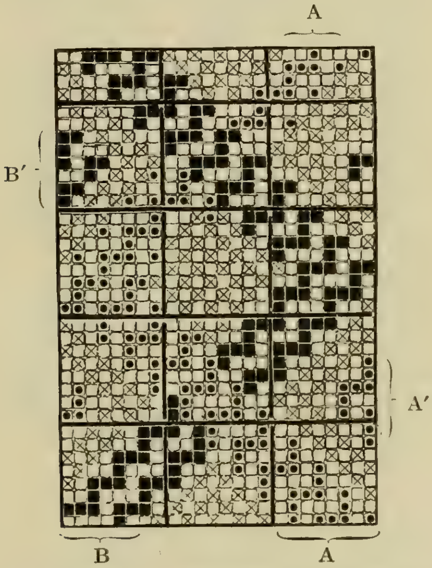


FIG. 207.—INTERSECTING STYLE.

units, such as those which contrast with each other in effect, the sections giving the diamond features are variously decorated; so that the textures may be manufactured in one kind of yarn in the warp and in a second kind of yarn in the weft, or they may be manufactured in one quality and count of yarn for piece-dyeing.

For the application of this base to the diagonal scheme of pattern-making, the design in Fig. 208 may be considered. Here one set of details—in $_{2}{}^{4}{}_{2}$ twill or the zig-zag—is employed for intersecting with the constant twilled lines woven in solid

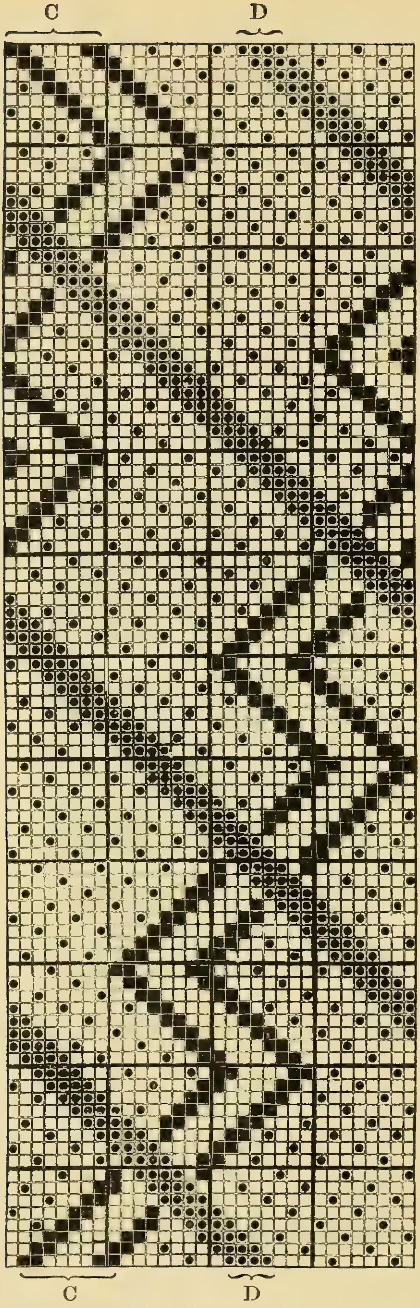


FIG. 208.—INTERSECTING DIAGONAL.

floats of weft. Both sets of detail might be interlaced, that is, the lines C made to traverse alternately over and under the lines D. The weaves used in the development of the pattern are important, for these require to impart a clear, definite quality to the diagonal line, and to be in strong contrast with the ground plan. Employing, as in this illustration, sateen for the ground, weft twill for effects D, and an 8-end twill for effects C, gives a suitable degree of textural differentiation in the three species of detail combined.

Fig. 209 is illustrative of the intersecting design basis when the figures in the repetition of the pattern are detached from each other, but disposed in a uniform relation, with one figure exactly opposite the other. Analysing this arrangement, it will be noted that the twin sections of the semi-lozenge figures are interlaced but filled in respectively in diamond intersections, and in graduated upright weft twills. With two similar or identical forms united in this manner in single transposed decorative figures, it is advantageous to develop them in crossings differing from each other in character. Moreover, it is likewise essential to apply a ground weave, which, as in this example, will give a neat, firm cloth, or one equally effective in bringing out the two or more interlacing pattern features. With certain sections in this design in a warp diamond make, combined with other sections in weft twill, arranged on a rib or cord ground—run into close contact with the former, but allowing compact floats of warp adjacent to the latter—retains the quality of pattern expression desired.

The examples studied have made it evident that should the weave units, employed in the production of interlacing designs, be sufficiently distinct in structure as to impart clearness of pattern style, this practice of design origination resultsin satisfactory and original classes of dress manufacture. The subject is more elaborately presented in Fig. 210, a form of pattern in which a quadrilateral figure is interlaced with a broad, waved band, A. The variety of interlacing work it comprises is dependent for forceful delineation in the fabric on the

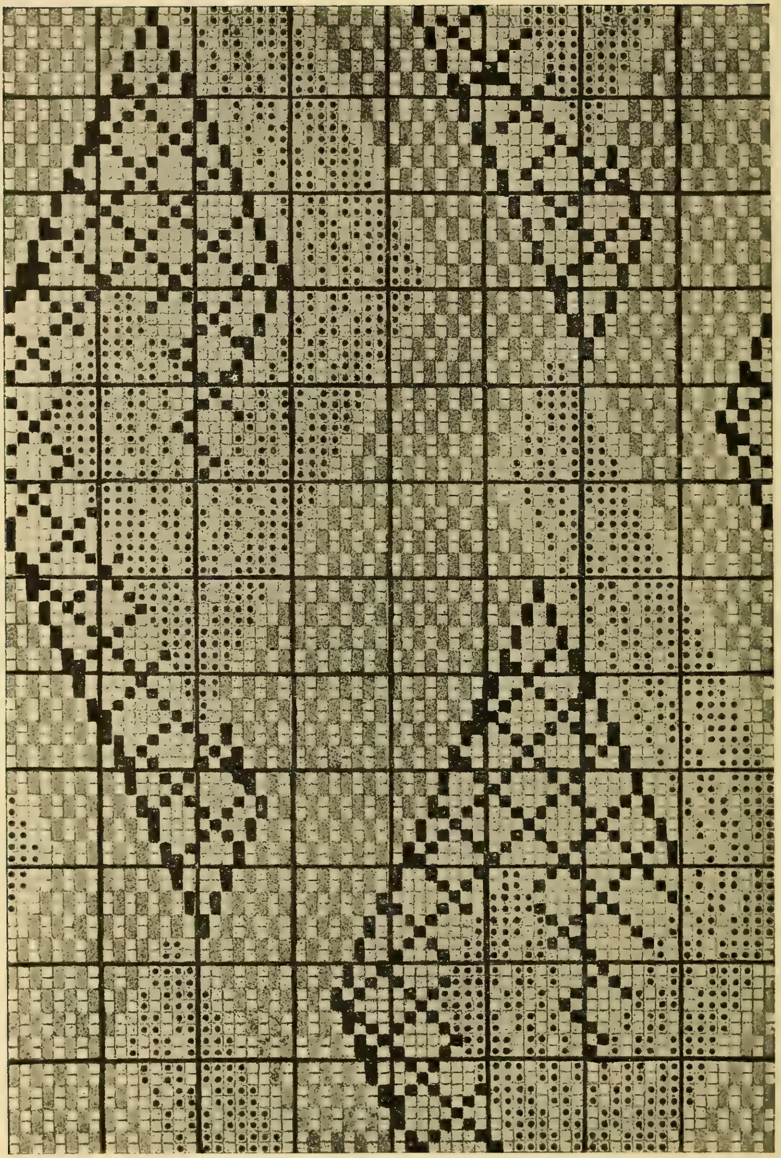


FIG. 209.—INTERSECTING SPOTTED TYPE.

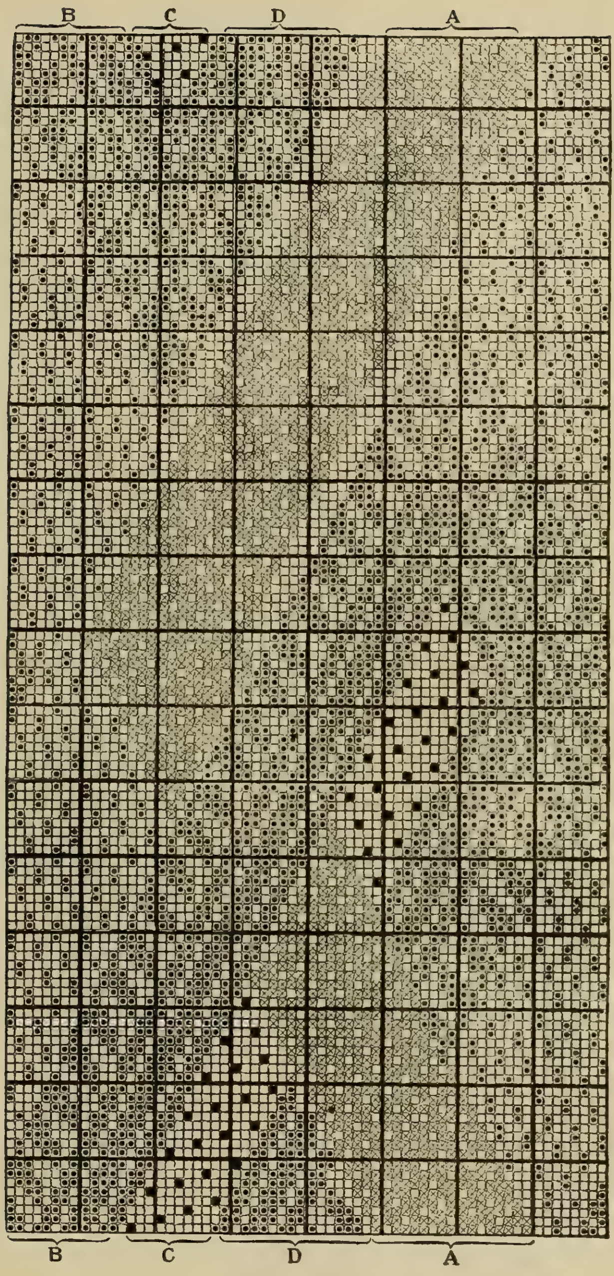


FIG. 210.—INTERSECTING GEOMETRIC BASE.

weaves employed being correctly adjusted. This technicality has been considered in working out the designs in Figs. 208 and 209. In planning a pattern of this order, its dimensions on point paper are first determined. Then follows the sketching in outline of the principal figuring, and that of the waved line A, which, in width, should be made proportionate to the other decorative details in the design. Next comes the question of the weave elements, and of their utility and fitness in developing these simple form units. It should be observed that the irregular joining of the weaves together detracts from the value of the woven result. Considering band A as a primary ingredient of the style, it is, in Fig. 210, developed in 5-end sateen, so that it appears as a toned effect in the cloth. If a weft twill were used instead of the sateen, it would sharpen the definition of the waved line, but cause it to be too prominent a characteristic of the ornamentation. For emphasizing the central portion of the figuring B, across which the weft sateen band is formed, a 10-end warp sateen has been selected, and this would obtain the requisite accentuation of the parallelogram form C. Sections A, it will be noted, also interlace with the lines D. Now by constructing these in upright weft twills, and in shaded twill moving from the extreme edge of the figure, and by applying a buckskin twill to the ground, the elemental details, as well as the form types in the design, would be as clearly defined in the fabric as on the point paper. It will be observed, on examining the illustration, that the several crossings, though differing substantially in textural effect, fit regularly with each other, so that the design would yield both a neat build of cloth and a suitably ornamented woven surface.

Various schemes of manufacture are suitable for patterns constructed on this basis. Four such schemes, adapted for Fig. 210, are appended—

I. 80's 2-fold Silk Warp and 40's Silk Weft.
40's reed, 3 threads in a dent,
100 shots per inch.

II. 2/60's Cotton Warp and 30's Cotton Weft.
32's reed, 3 threads in a dent.
90 shots per inch.

III. 2/50's Cotton Warp and 20's Artificial Silk Weft.
40's reed, 2 threads in a dent.
80 shots per inch.

IV. 2/72's Worsted Warp and 36's Worsted Weft.
22's reed, 4 threads in a dent.
84 shots per inch.

211. *Diamond Structure of Pattern.*—As a basis of weave effects, this geometric form has been dealt with in Paragraph 157. It has now to be considered as a basis of design composed

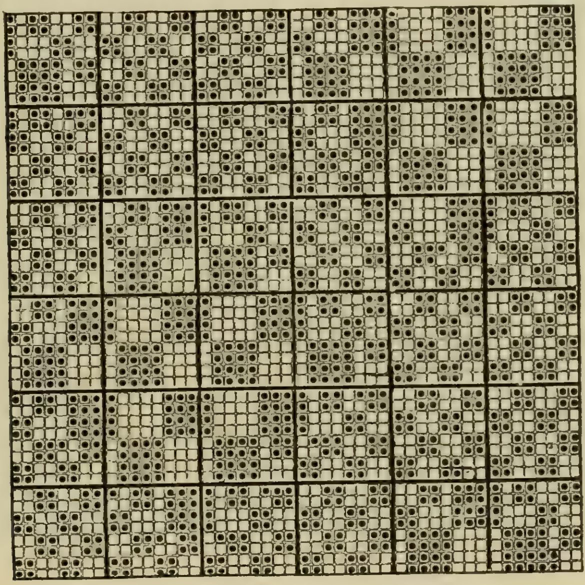


FIG. 211.—DIAMOND BASE IN MAT WEAVES.

of various plans of intertexture. The practice of dividing the pattern area into equal or unequal sections by interlacing lines in a diamond relation may be utilized, developing the ground and figured parts in different weave units, as in the combination of a fine or fast weave for the former, and a more open type

of weave for the latter. Dividing the design in this way, ordinary diamond forms—at equal distances apart, as in Fig. 211—may be arranged in some simple weave such as 4-and-4 mat, when either the 2-and-2 hopsack or the plain

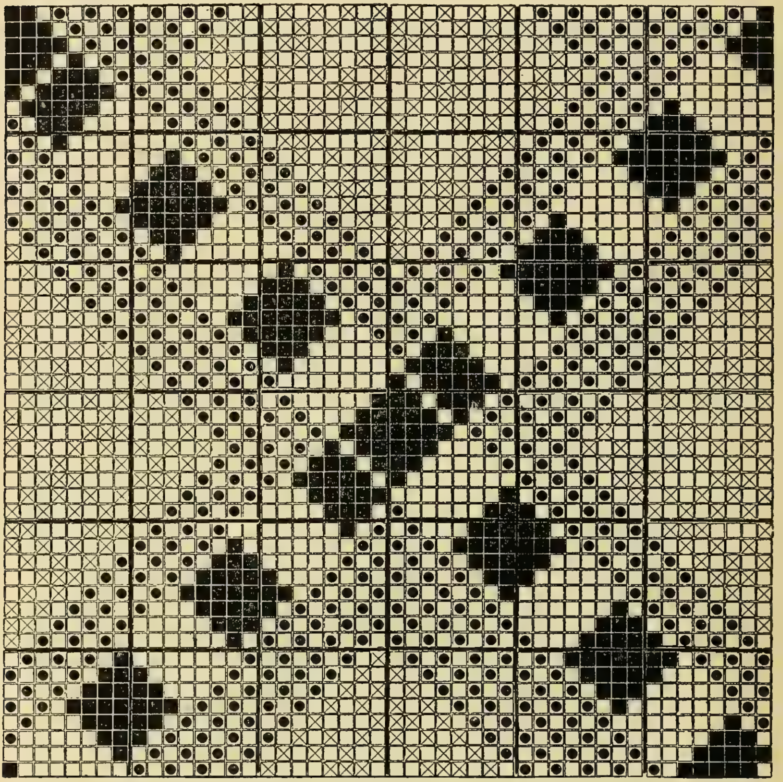


FIG. 212.—DIAMOND TYPE IN PLAIN, MOCK LENO, AND WARP AND WEFT EFFECTS.

make would be applicable to the ground features. Obviously, the diamond shapes might be woven in reversed twills in the figuring and in the ground respectively. But, as a rule, for these styles, the weave for the diamond figures should be of a regular type, with a weave of a corresponding but closer structure, for the surface area of the pattern.

It is, however, in the employment and combination of correct weave elements that the more meritorious of these examples are obtained. This is enforced in the designs illustrated in Figs. 212, 213, 214, and 215. These are typical of developing the style base; (1) in open weaves, with the

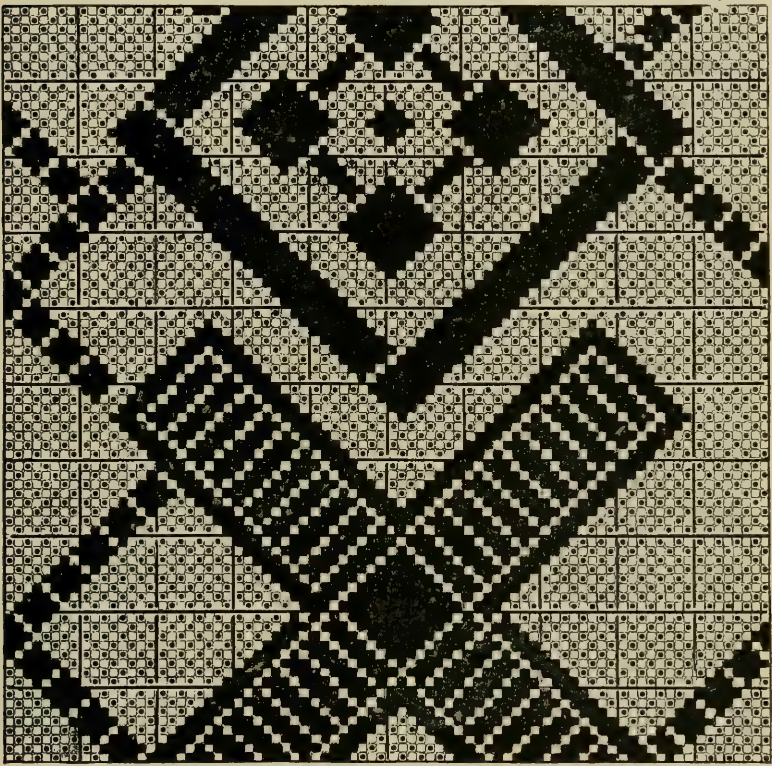


FIG. 213.—DIAMOND TYPE: FIGURED IN THE WEFT.

diamond units in a faster weave; (2) in duplicating the diamond figuring; (3) in combining diamond forms with other geometric figures, and in ornamenting the ground of the texture with a number of decorative details; and (4) in intersecting diamond with lozenge forms. In each, as will be demonstrated, there are two primary characteristics, that of acquiring

a decided and varied pattern type, and that of acquiring diversity of textural surface as the result of assorting weave elements differing from each other in effect in the cloth.

In Fig. 212 it is not so much the arrangement of the pattern base, which is of the ordinary variety, as the weaves used which form the instructive feature. They render an otherwise simple design scheme diversified in surface details, and in decorative quality. Developing the inner and smaller diamond sections in mock leno, and surrounding these with plain weave,

FIG. 214.

imparts tone to the figuring, and produces a useful build of cloth. In addition, these weave units are in bold contrast with the diamond-shaped details in warp and weft, which define the larger and chief ingredients of the style.

While both warp and weft intersections are used in expressing the pattern details and features in this example, in the next illustration, Fig. 213 (sectional plan), the weave units are so planned as to prevent the warp yarns from appearing for more than one intersection at a time on the face of the cloth. This is the principle of design applied in weaving alpaca and silk union fabrics, where the figuring is a resultant of the shuttling yarn. It restricts the weaving scheme, and involves the

textural features being obtained by changes in the order and in the length of the weft interlacings. Recognizing this factor, it becomes a problem of determining the requisite degree of accentuation to be given to each species of line and

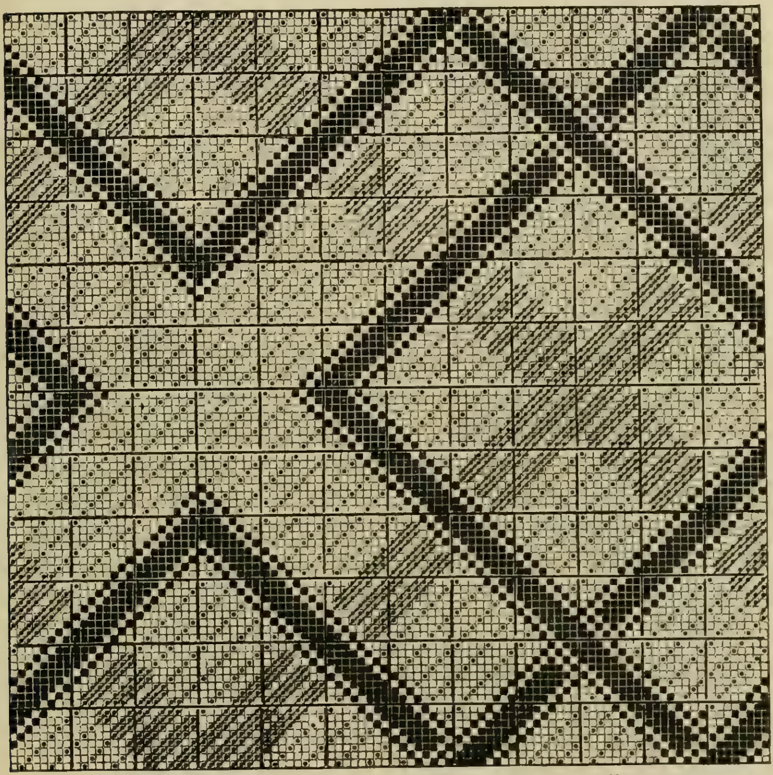


FIG. 215.—DIAMOND BASE WITH INTERSECTING DETAILS.

element in the pattern structure. Studying the woven specimen, Fig. 214 shows how the observance of these data has enabled the weave types to be so used as to give freshness to each sort of ornamental work. The fine ground texture—usually plain or weft prunelle—is of the character for contrasting with the form types developed in twill, small diamonds, and other intersections, and by floating the picks on the surface

of the fabric, and limiting the intersections of the warp threads to single and detached units.

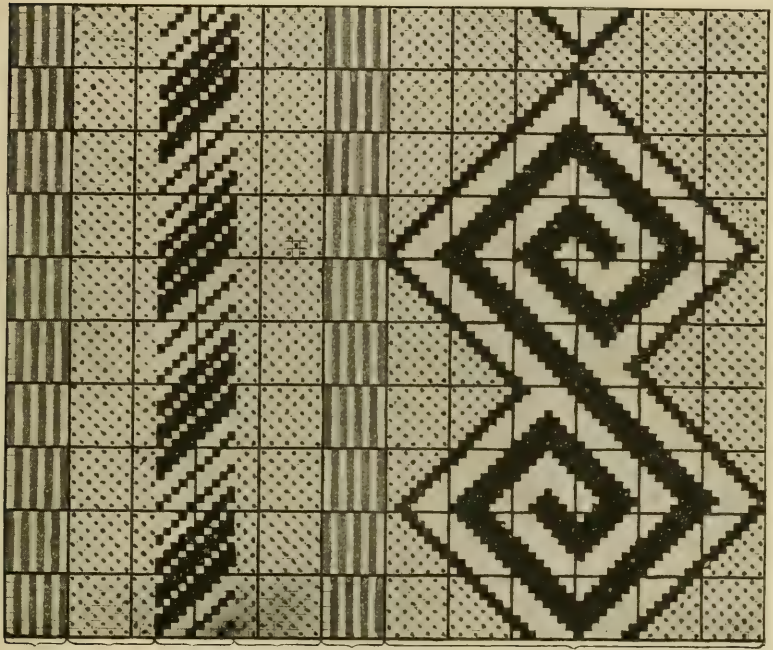
In regard to the geometric forms in the design, the stronger and severer of these are the X-shaped figures, and for the purpose of lessening their prominence in the cloth as compared with the diamond figures, they are woven in $\frac{1}{3}$ weft twill, with the central spottings developed in a distinctive tone, by flushes of weft extending across as many as 12 threads of warp. Other decorative types, which are more clearly delineated, are composed of 7-and-1 of weft twill, and of 3 to 11 weft floats, as in the rectangular group of diamond details. The lines linking one type of pattern with another, and for ornamenting the ground-work, are woven in a small diamond plan of weave.

Like principles of intertexture have been practised in the construction of the example in Fig. 215, where lozenge and diamond figurings interlace with a larger scheme of figuring expressed in 4-shaft weft twill. In this case, however, the ground weave is $\frac{3}{1}$ warp twill, making a design adapted to manufactures in which the warp, in addition to the weft yarns, are employed in producing the surface features in the fabric. This designing practice is applicable to dress textures consisting of cotton, linen, or of mixed cotton and worsted yarns, and also to silk goods. The principal figuring lines are formed by floating the weft over five threads in succession, and binding them at the edges with plain interlacings for clearly defining their textural quality. As the pattern is constructed, there is a large diamond figure (marked in ⧄'s) underneath the section marked in ■'s.

Other species of weave ornamentation might be substituted for those employed, such as sateen for the bold twilling, $\frac{2}{2}$ cord for the $\frac{3}{1}$ weft twill, and $\frac{2}{2}$ twill as the ground crossing : in addition, the central parts of the larger figures might be decorated with plans of the diaper construction.

As showing the method of using the diamond base in the formation of elongated figures, section A of Fig. 216 may be

examined. One of the lines of the lower diamond type is continued to form the opposite side of the upper diamond, so that the two units give a compound form of figure. This is developed in clear floats of warp and weft, and on a plain ground. If the figures were constructed in broader proportions, the twilled lines might be varied or vandyked with weave



B D C D B A

FIG. 216.—STRIPED COMPOUND.

details. But in the scale here shown, the working out of the plan, in one well-defined weave scheme, is more appropriate. As illustrated, it would produce a forceful striped design; for adjoining the two sides of band A are the stripes in 8-and-8 warp repp, and these are combined with bands of plain intertexture, centrally decorated with the fancy twilled section C. By considering the effect of the following order

of colouring on the pattern, other technicalities in this arrangement and structure will be apparent—

Warp:	1 double thread of light cotton or silk	(*a*)	for 8 threads.
	1 ,, ,, fancy ,, ,,	(*b*)	
	11 threads of toned cotton or silk	(*c*)	
	10 ,, ,, ,,	(*d*)	
	11 ,, ,, ,,	(*e*)	
	1 double thread of light cotton or silk	(*a*)	for 8 threads.
	1 ,, ,, fancy ,, ,,	(*b*)	
	48 threads of toned cotton (*c*).		
Weft:	Toned cotton or silk (*d*).		

According to this order of colours, the figuring in ☐'s, in band A, would be in tone *c*, and the figuring, in grey, in tone *d*. As to sections B, these would not be modified by the weft, and would consist of transverse lines of the light tint *a*, and of the fancy tint *b*. The twilled section *c* in ■'s would be woven in tone *d*, with the warp effects in tint *a*, while the plain weave ground in the two larger stripings would be in tones *c* and *d* and in *a* and *d*. Hence there are here several contrasts in colour as well as in design features resulting from the arrangement of the weaves constituting the figuring, and of the bands in rib, diagonal, and plain make respectively. It is a cast of pattern capable of some variation: thus the rib sections might be changed to twill, and the diagonal parts to a diaper crossing, with the method of colour diversified as to hue and tint, and as to order of warping.

212. *Lozenge-shaped Types.*—Two illustrations are supplied on this basis in Figs. 217 and 218. Fig. 217 is obviously a variety of elongated diamond pattern, being formed in "cutting" weave elements so as to be useful in simple schemes of colouring. Thus there is in the design the well delineated lozenge figure composed of flushes of warp, with its interior features consisting, in one section, of certain checked crossings, and, in the other section, of angled $\frac{3}{3}$ twill.

Diversity of textural construction, with the development of a balanced decorative pattern, should be the prominent

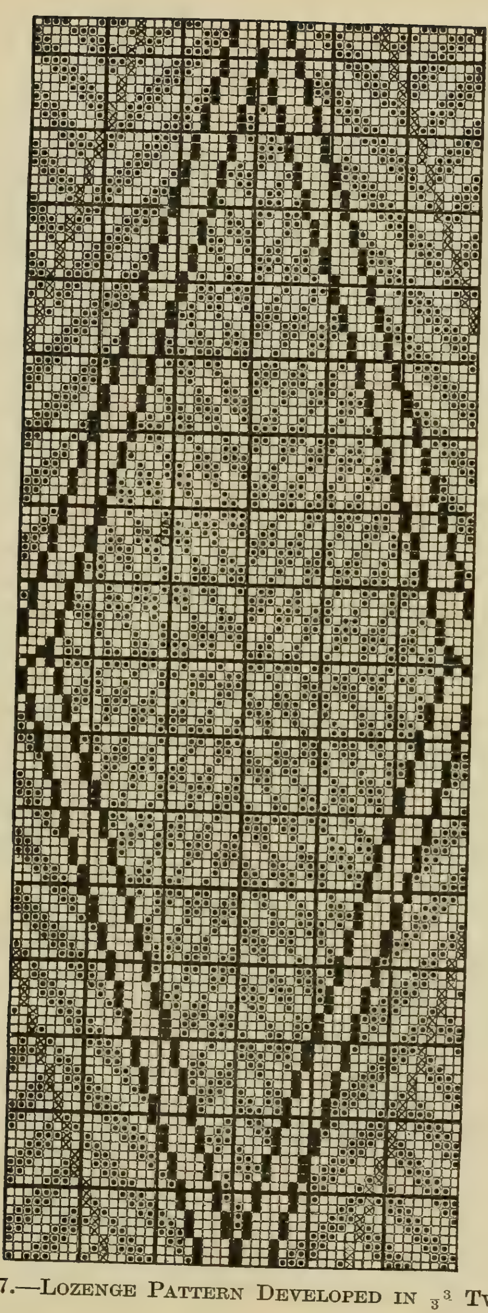


FIG. 217.—LOZENGE PATTERN DEVELOPED IN $\frac{3}{3}$ TWILL.

characteristics of this type of design. Fig. 218 is suggestive of the method of modifying the basic structure, and of the technical practice in expressing the form units of which the style consists. This example is composed of two large lozenge figures, grouped on the "drop" principle. The outlines of the figures are rendered distinct in tone by the compact floats of weft twill and sateen in which they are produced. With the colour of the weft yarn differing from that used in the warp, the sectional parts of the style in ■'s and in ⊡'s would be quite clearly emphasized in the woven manufacture. The manner in which the interior of the figures has been decorated with weave detail is illustrative of a special scheme of textile design. These details shade from clusters of diamond spots at the upper apex of the lozenge figure, to single separated spots at the base of the figure. Other varieties of spotting, such as effective weave elements, might also be combined in this way.

Three methods of producing the design (Fig. 218) in silk, worsted, and cotton, are suggested in the particulars specified below—

(1) Silks.	*Warp:*	80's 2-fold light tint.
	Weft:	30's medium tint.
		120 threads and 100 picks per inch.
(2) Worsted.	*Warp:*	2/60's Botany.
		25's reed 4's.
	Weft:	2/60's Botany.
		96 picks per inch.
(3) Cotton.	*Warp:*	2/60's light tint.
		40's reed 2's.
	Weft:	30's medium tone.
		80 picks per inch.

213. *Compound Geometric Types.*—"Compound Weave" designs also include figured styles consisting of two or more types of geometric forms. Several examples will be analysed, especially such as are suggestive in the base of construction, and in the weave units combined. Taking, firstly, a compound lozenge and rectangular scheme of pattern—that

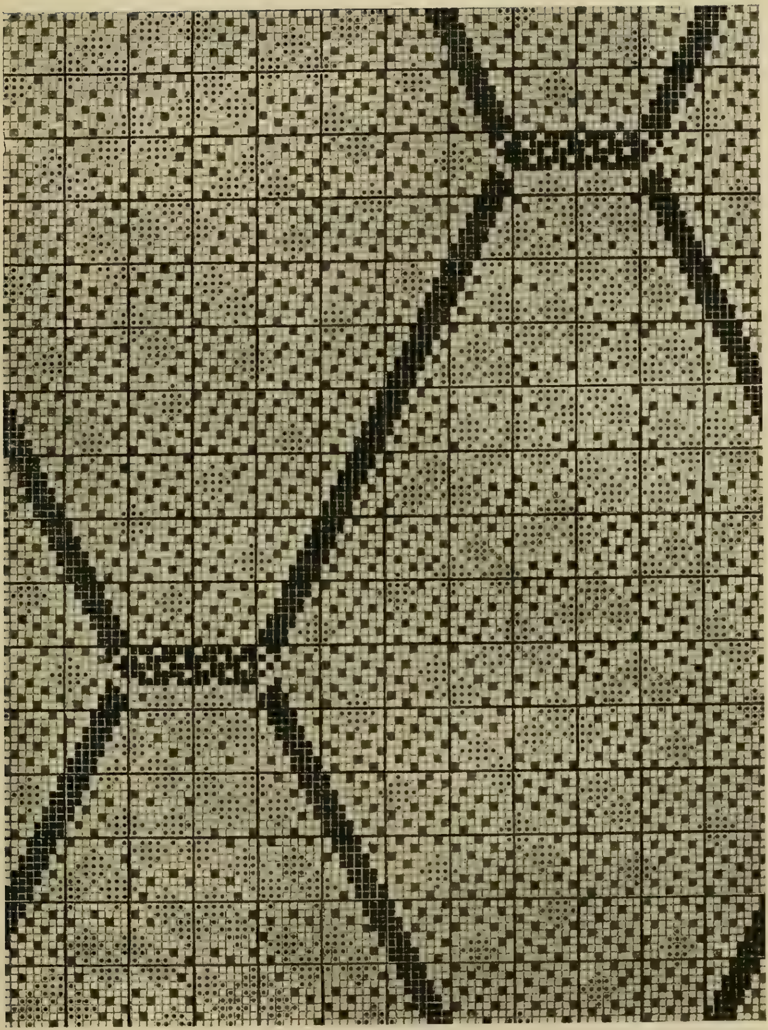


Fig. 218.
Lozenge Type Developed in Sateen and Spotted Effects.

illustrated in Fig. 219—it is formed of areas of $\frac{2}{2}$ twill, and of $\frac{3}{1}$ and $\frac{1}{3}$ swansdown, with the diamond and rectangular figures set across each other. The complete pattern is so regular in plan of formation and in weave structure as to be useful in thick or fine yarns, and yet give, without the addition of colour, a neat and clear textural design.

Secondly, the practice in combining serpentine work with star spotting and striped features is shown in Fig. 220. This is a more complex and diversified composition. The design

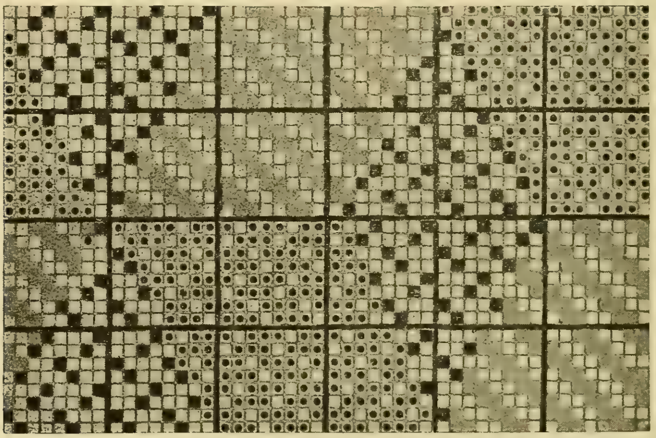


FIG. 219.—SIMPLE GEOMETRIC TYPE IN 4-SHAFT WEAVES.

elements are executed in weft repp plans. The style, as so formed, exemplifies the diversity of pattern producible in weft cord plans on a warp-twill surface. For developing the interlacing star details, the ground adjacent to such is woven in plain rib, that is a weave which forcibly differs in effect from the 5-end sateen used in other portions of the striping between the zig-zag lines B, B′. Considering it is as weavable in one colour of warp and weft, the effects in ■'s would be in solid floats of the latter, the ground in fine warp twill, and the other sections, printed in ⊡'s, in sateen and plain rib. Assuming it, in the next place, to be produced in a light tone of warp and a deeper tone of weft, the weft features would be

more distinctly brought out in the fabric; or, should it be coloured in the warp by some such method as that given below, the style would be further modified and enhanced—

Warp:	18 threads of light heliotrope cotton or silk (*a*).					
	12	,,	tinted	,,	,,	(*b*).
	18	,,	light	,,	,,	(*a*).

Weft: A medium tone of heliotrope cotton or silk.

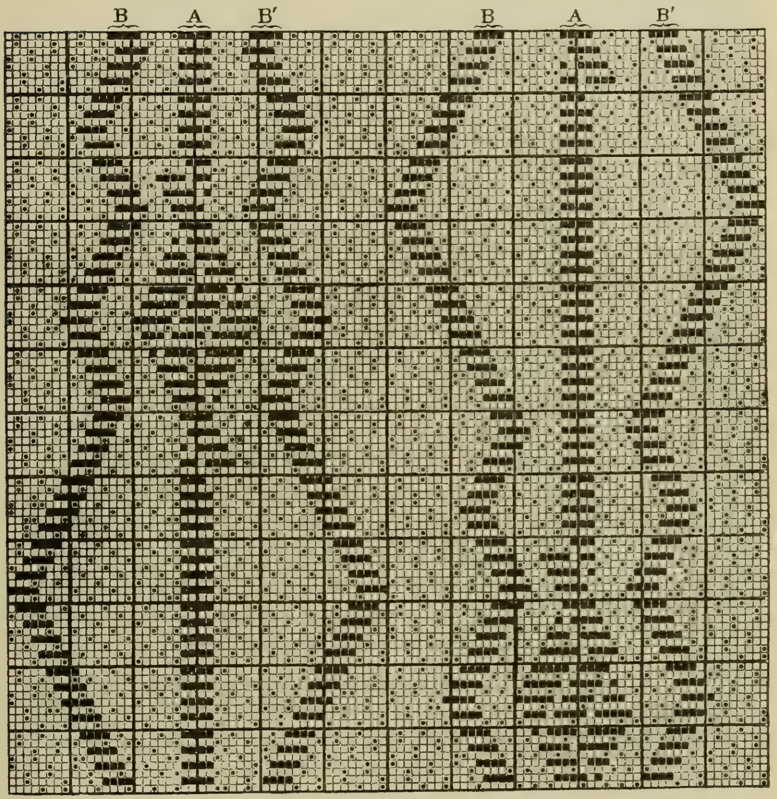


FIG. 220.
GEOMETRIC TYPE IN CORD, SATEEN, AND TWILLED WEAVES.

This looming arrangement would result in the repp figuring being expressed in the medium tone of colour with the edges of stripe A in tint *b*, and the ground features in the light tint.

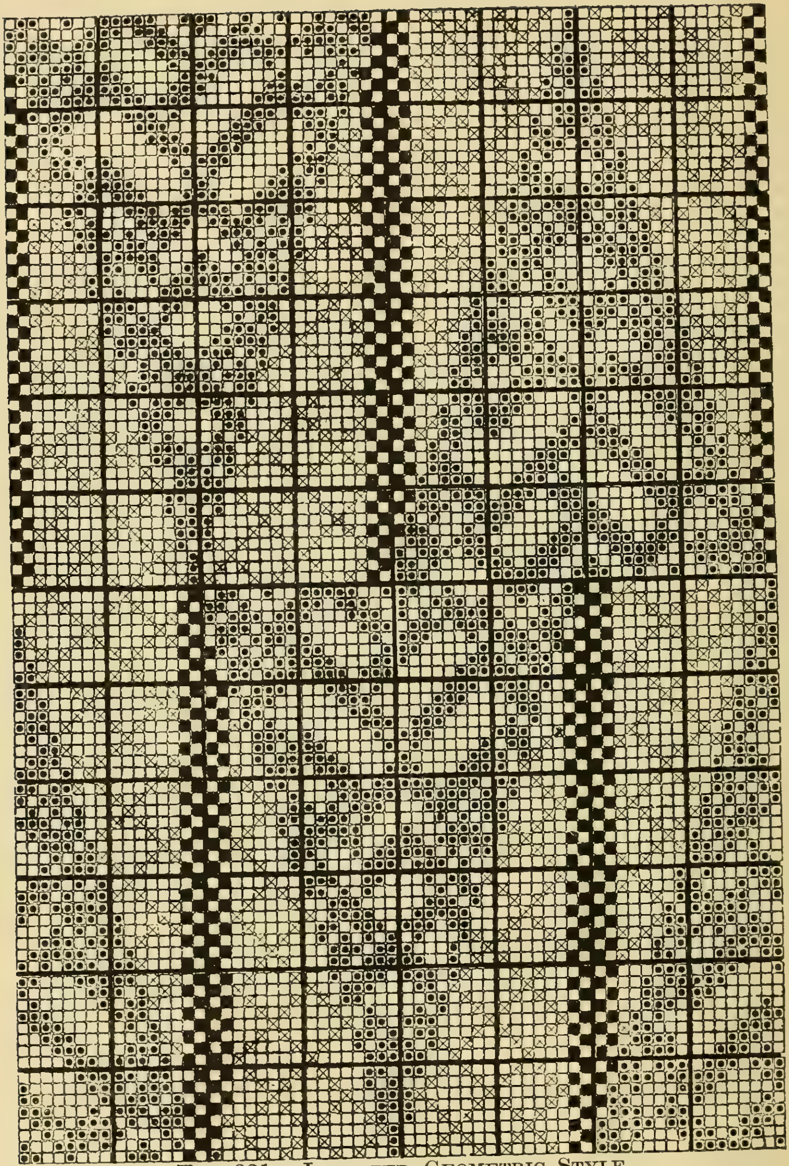


Fig. 221.—Inverted Geometric Style.

The third example (Fig. 221) is based on the combination of inverted triangular figures and bi-sected parallelogram forms. There is, in this pattern, an order of weave grouping which is specially adapted to fine-set cotton, linen, and silk manufactures, namely, plain and diamond makes, with zig-zag twilling. On this account the style is not applicable to woollen yarns, but the crossings combined make it suitable for giving diversity of textural style in cotton and silk goods. Thus it would give intermittent stripes in plain weave, sections in diamond effect, and sections in shaded, angled twill. Patterns of this formation are effective, whether produced in one or several colours. This is owing to the pronounced weave effects of which they consist, the character of the design being determined by the weaves applied, as well as by the geometric base employed.

214. *Combination of Transposed and Checked Pattern Bases.*—The compound base of design construction, seen in Fig. 222, is representative of a class of diamond pattern developed in shaded twills. The repetitions of the design develop a checked character, with the addition of the spottings in ■'s—which are intended to be woven in extra picks of weft, and the method of their insertion will be considered in Chapter VIII. The design has been produced by outlining the features B, B′, and working these out in twills shading from a 5-float of warp to a 5-float of weft, so that if the warp yarns should be a light colour and the weft yarns a toned colour, the edging of the figures would be in a toned shade, graduating to a light shade in the central portions of the figures. The areas of the pattern, intermediate between B and B′, are rectangular in shape, but drawn in curved lines. Shading, in these sections, proceeds from a maximum weft element in the centre to a maximum warp element at the extremities, the twilled lines being made to agree with the formation of the star checkings. Sateen weaves might be similarly graduated, or, by enlarging the pattern to 192 threads and picks, warp cord, and other warp-face weaves might be used for the sections in grey, and

weft cords or weft-face weaves for the effects in ☐'s. As illustrated, the design is weavable—

(1) In 96 denier organzine silk warp and
90 „ tram „ weft.
180 threads and 170 picks per inch.

(2) In 2/80's cotton warp and 60's cotton weft—
140 threads and 132 picks per inch.

(3) In 2/80's worsted warp and weft—
120 threads and 112 picks per inch.

215. *Circular and Geometric Forms.*—While the scroll and circular types of figuring will come under consideration later, reference should be made to the design principles, in which circular and geometric forms are combined. Fig. 223 is typical of this style of decorative pattern work. It is primarily applicable to union dress fabrics with a worsted warp and silk weft, the ground consisting of warp-cord, with the figuring in weft-cord, weft-diaper effect, and weft-sateen.

This example is well-diversified in weave arrangement, and, considering the limited number of threads and picks which it occupies, it is interesting in ornamentative structure. The figured types are arranged on the drop base, with the two principal ones opposing each other, and placed at equal distances apart. By colouring on various systems in the warp and weft, different styles of pattern development are acquired. In the first instance, assuming the warp to be 2/80's medium shade worsted, and the weft a light shade of silk, then the various parts of the figuring would be more or less defined in tone, according to the weave in which they are formed, with the ground of the texture woven in repp, and in the shade used in the warp yarn. Second, such designs are producible in cotton and silk, the combination of the weaves applied being adapted to the manufacture of fine, thin textures. In preparing this looming plan, as also in those in Figs. 209 and 210, both the selection of the weave units, and the arrangement of the figuring are important technicalities. The weaves employed should not only combine satisfactorily, but make a

sound fabric and give suitable prominence to the component parts of the style.

216. *Design Construction on Weave Bases.*—" Weave " bases, on which to construct designs composed of various weave units, are utilized in the origination of simple figured patterns.

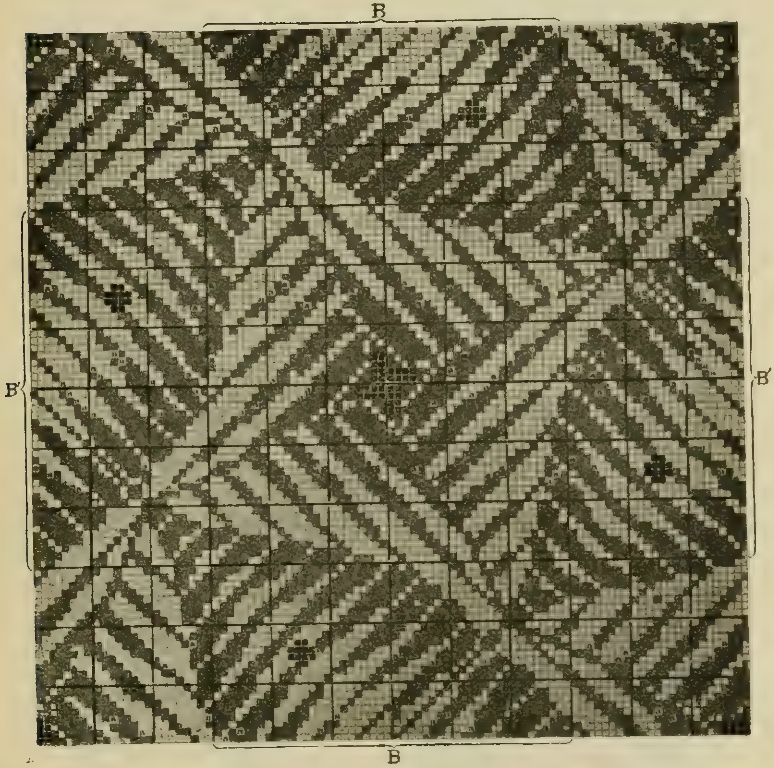


FIG. 222.—DIAMOND CHECKED STYLE IN SHADED TWILLS.

They offer certain advantages—in the first place they form a known mathematical scheme of detail arrangement and distribution ; in the second, if the weave units are, in themselves, effective plans, they result in well-balanced types of design. Moreover, such bases are capable of extension in several ways, as for example, in working out patterns composed of weaves

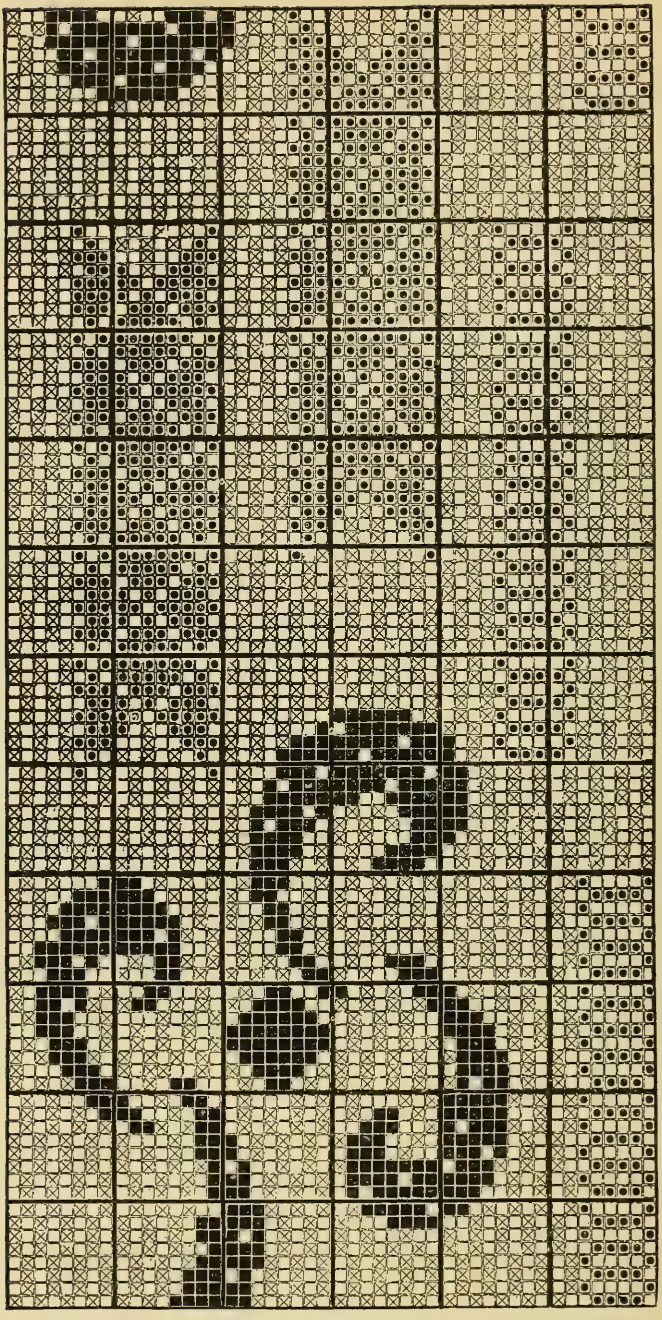


FIG. 223.—SPOTTED TYPE WITH WARP-CORD GROUND.
(*Section only, similar design base as Fig.* 238.)

derived from the original base, and second, of weaves of an entirely distinct character, but necessarily grouped in agreement with the scheme of intersection in the original plan.

The primary technicalities to consider are the structure of

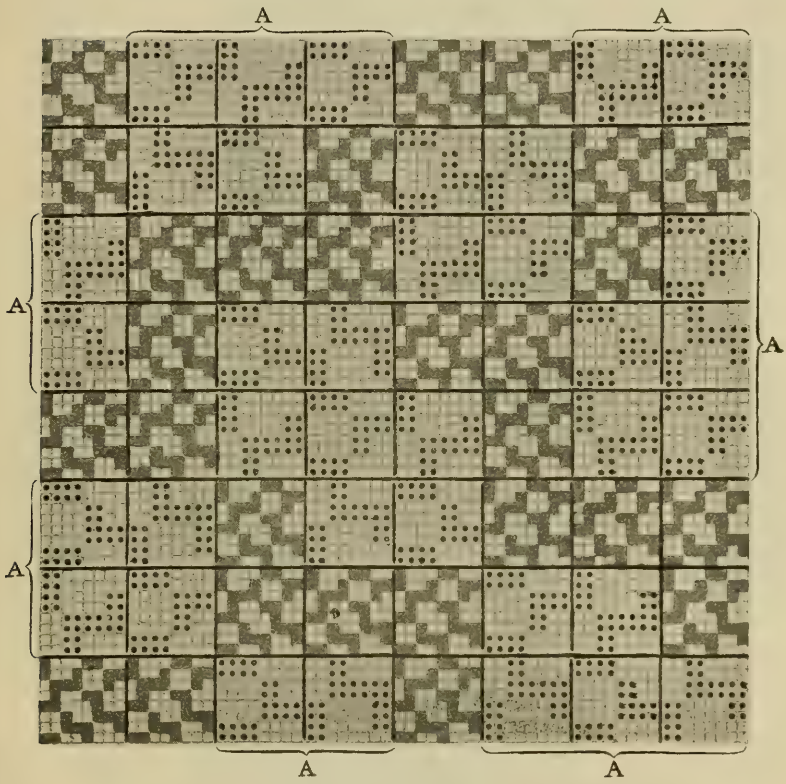


FIG. 224.—DESIGN CONSTRUCTED ON WEAVE BASE.

the weaves selected, and the several varieties of weave effects to be combined with each other in the different sections of the extended design, and which the intersections of the basic weaves represent. To make this clear, Fig. 224—on 64 threads and 64 picks—is a pattern which has been acquired on the interlacing plan shown at Fig. 224A. Each section in this weave is equal to 8 threads and 8 picks in Fig. 224. Duplicating this weave

gives the plan at Fig. 224B, which has been applied to sections A in Fig. 224, corresponding to the ⊡'s in weave B, and

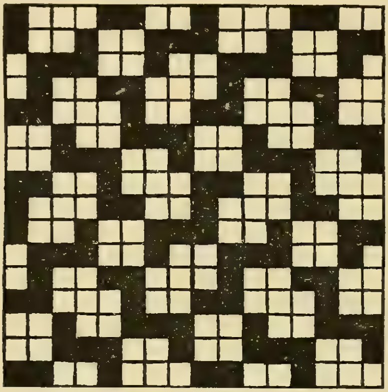


FIG. 224A.

weave A itself to the ground in Fig. 224, which further coincides in arrangement to the weft intersections in ■'s in plan B.

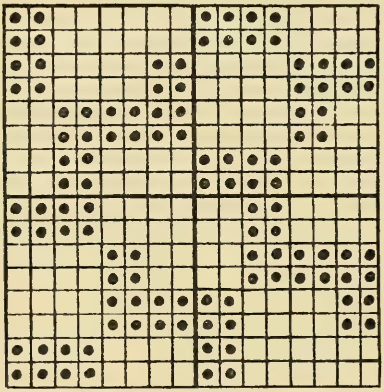


FIG. 224B.

This example is illustrative of the employment of one weave structure in producing the whole design scheme, that is, first, as the ground effect; second, in its duplicated form, in defining

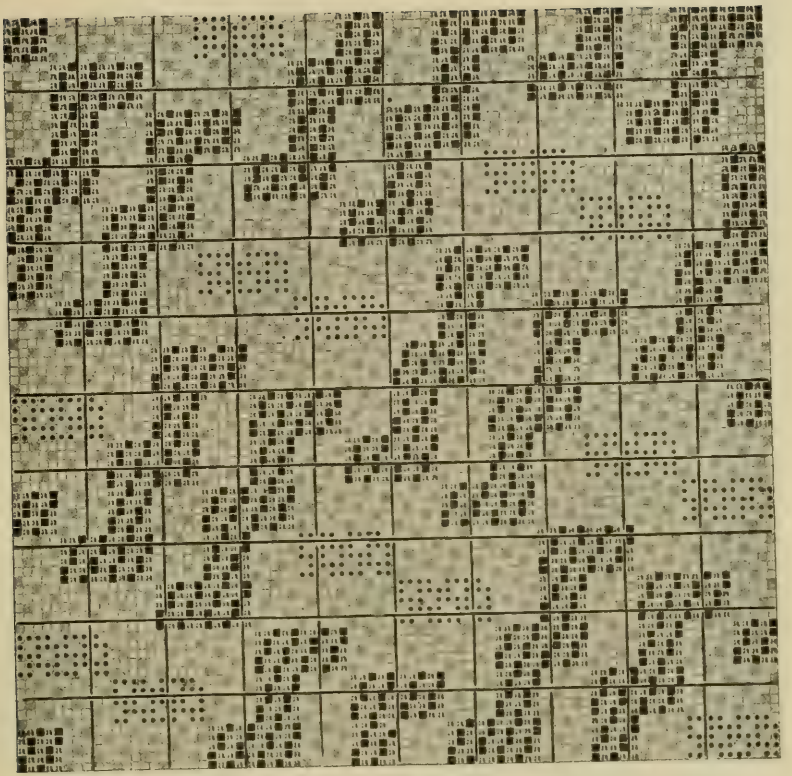


FIG. 225.—DESIGN FORMED ON WEAVE BASE.—PLAN 225C.

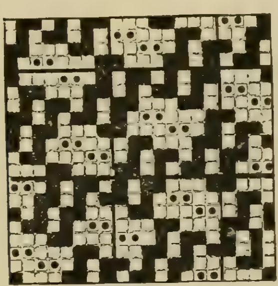


FIG. 225C.

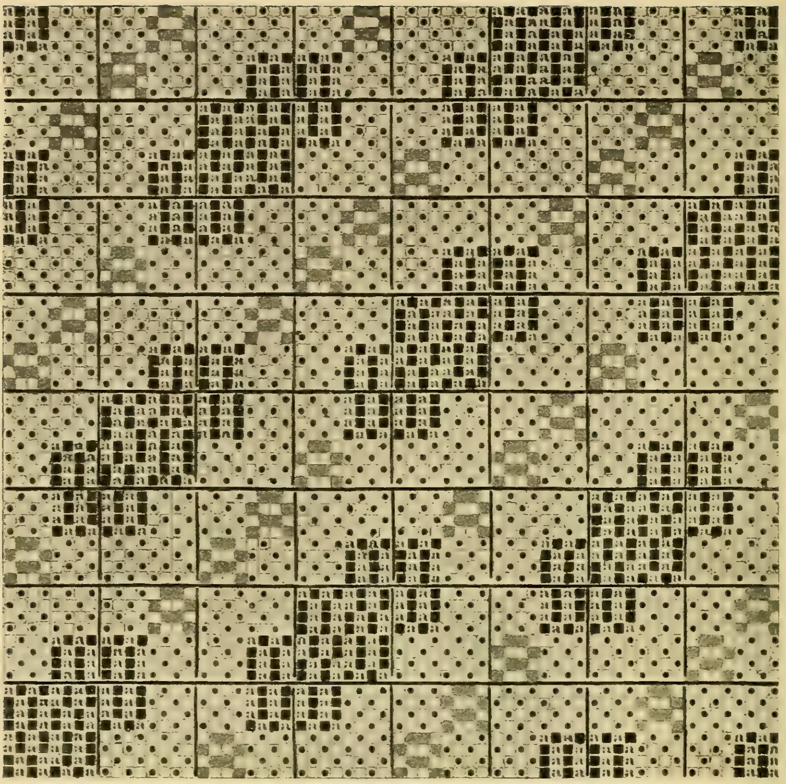


FIG. 226.
DESIGN FORMED ON WEAVE BASE.—PLAN 226D.

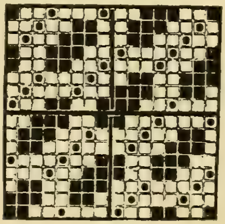


FIG. 226D.

the figured features; and, third, as the basis of figure distribution.

The second practice, in which different weaves are used in the development of the figuring other than those derived from the structural plan, is illustrated in Figs. 225 and 226. It will be seen, on comparing Fig. 225c with Fig. 225, and Fig. 226d with Fig. 226, how the weave plans have been followed in working out the compound designs. In the first of these examples, the sections in Fig. 225c are developed in weft Venetian in Fig. 225, the sections in ⊡'s in weft-sateen, and the sections in □'s in warp-sateen, thus giving a pattern of an identical formation as that of the basic plan, and developed in warp, weft, and intermediate warp and weft effects.

Considering Fig. 226d in relation to Fig. 226, the sections in ■'s in the former are developed, in the latter, in warp repp; the sections in ⊡'s in weft cord; and the ground or unmarked sections in plain weave. By changing the weft-repp to a weft-twill, this build of design would be suitable for a union fabric with cotton warp and alpaca or artificial silk weft, but, as arranged, it is intended for a texture in which the warp yarns would be the principal figuring factor.

The study of the Weave Structures, illustrated in Chapter V, made it clear that plans of intersection are, in reality, types of textural effect, that is distinctive but minute forms of pattern. This being so, the regular and special groups of plans—other than the standard twills and their derivatives—are adaptable, by the methods described, to the production of geometric styles of figuring, and should, in this relation, be more extensively applied to the different classes of patternwork characteristic of the dress trade.

CHAPTER VIII

SPOTTED AND MOSAIC PATTERNS

217. *Design Details.*—In blouse and dress-fabric manufacture, spotted styles are largely produced in each sort of yarn unit, and also in textures composed of several classes and counts of warp and weft. The patterns comprise a diversified range of design types and detail, developed in various schemes of cloth construction and weaving.

The decorative principles may first be analysed and illustrated. Neatness of effect, clearness of detail definition, and simplicity of style, are of paramount importance in all varieties of this class of textile designing. The types of pattern-work

employed are suggestive of minute but severe forms of ornament, acquired (1) by the combination of straight, waved, and circular lines on geometric and weave bases ; (2) by the grouping, in mathematical relation, of rectangular, oval, crescent and other forms ; and (3) by the assortment of two or more figured motives on a selected basis of style arrangement.

218. *Structural Principles—Straight-Line Spottings.*—In illustration of these structural principles of spotting, the sketches in Figs. 227 to 244, A, B, and C, are supplied. They are Japanese in idea and character, and are valuable here as presenting the methods of forming spotted types useful in the manufacture and design of light textures made of cotton, silk, worsted and other sorts of yarn. The elementary, straight-line effects in Figs. 227 to 232, differ in structure from the line patterns—striped and checked—which have been dealt with. Whereas the latter are formed by the plan of intersection or by the order of colouring in the warping and the wefting, in these examples the pattern units are the result of line grouping and arrangement, apart from the looming practice adopted. In their origination, it is a question of assorting and combining lines varying in thickness, length, and in plan of classification. Figs. 227, 228, and 229 exemplify these fundamental bases of pattern work. The first is the result of lines of equal length and breadth arranged at like distances apart, a form of spotted detail variable by the dimensions and thickness of the lines, and also by the spaces intervening their repetition in the cloth. The second, which is a checked type, being composed of three parallel lines in square sections alternating with ground spaces, may be similarly modified in technical practice. Fig. 229 consists of lines differing in measurement, so planned and distributed as to develop a waved species of design.

219. *Variation in Line Proportions.*—Lines dissimilar in thickness and length are combined in the origination of diaper, diamond, and other varieties of elementary figured effects, with a spotted design composition. The diaper

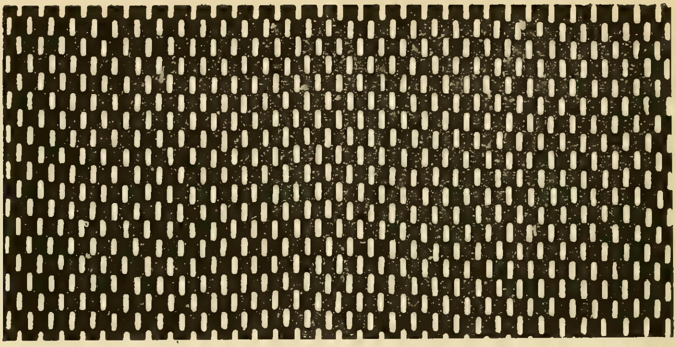


FIG. 227.

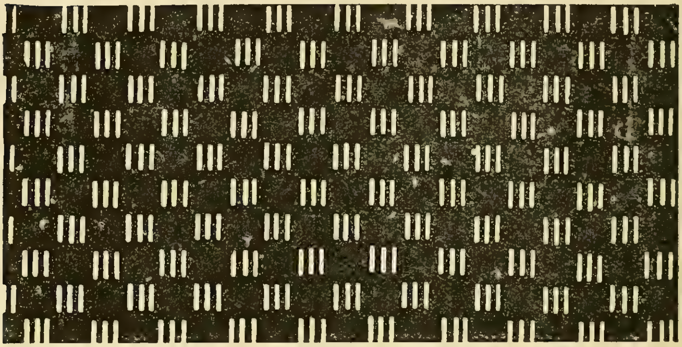


FIG. 228.

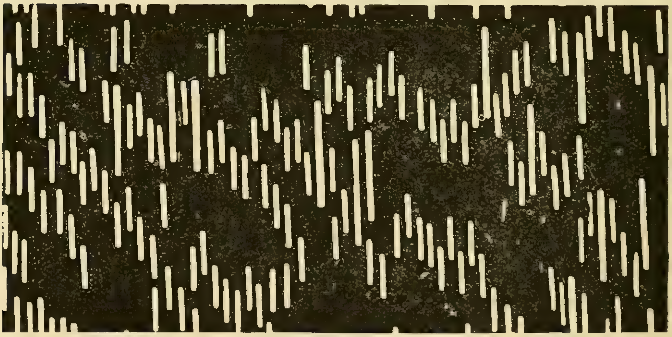


FIG. 229.
STRAIGHT-LINE SPOTTINGS.

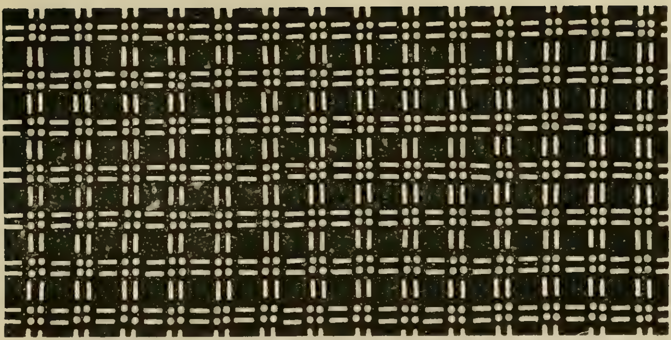


Fig. 230.

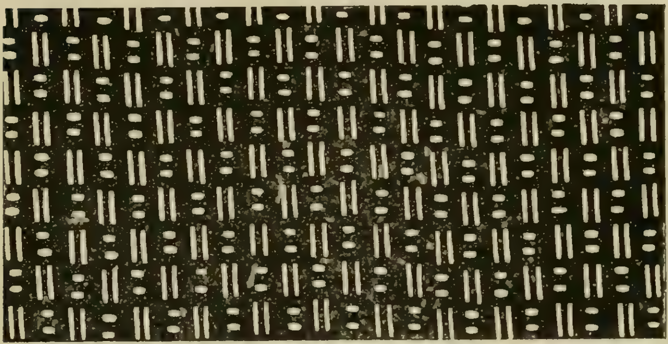


Fig. 231.

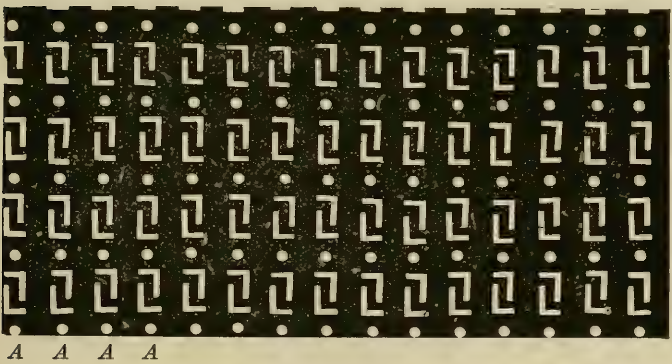


Fig. 232.

Straight-line Spottings.

arrangement is seen at Fig. 230, where four small details are linked with pairs of vertical and transverse parallel lines. For varying this principle, the size of the corner checkings is changed, and the method and order of grouping the spots in the checking units are altered, inserting, as desired, sets of three, four, etc., parallel and connecting lines. Combining lines of two sizes and in pairs, and setting these across each other, yields a species of basket work as seen in Fig. 231, again variable by the numerical order of the line details, but retaining the system of intersecting them at right angles. Triangular, and other sectional line motives, arranged on some common basis as in Fig. 232, are used in this class of spotting. In the example, the textural effect is rendered interesting by the insertion of circle details between the repeats of the transposed triangular shapes. This scheme of design is adaptable to striped styles by running several sections together comparatively closely grouped with each other, and following with a number of sections in which the units of effect are differently spaced : or plain ground sections may be made to intervene stripes of spotting consisting of any suitable number of the effects A.

220. *Circular Spotting.*—Circular and beadlike spotted designs are obtainable on various bases—two common and effective systems of construction being shown at Figs. 233 and 234. In the former, the larger spots are first grouped and then the small ones added, varying their diameters and number with the fineness of the texture, and the clearnes with which the effects are definable in the counts and sorts of yarn employed. Half-moon, crescent, and other segment forms are combined, which may be run in a twilled order—Fig. 234—or arranged on some such basis as illustrated in Figs. 230, 231, and 232. Combining two or more spotted types—each the result of several varieties of effect, and with the spotting base sateen, and emphasized or otherwise by increasing or lessening of the ground area—is a common practice in this class of designing. Alluding to Figs. 235 to

238, they are apparently diversified forms of the line and circular pattern types described. Fig. 235 is formed of intersecting lines, making the star features of transposed diagonal lines, and of circular details. It makes a diamond type of

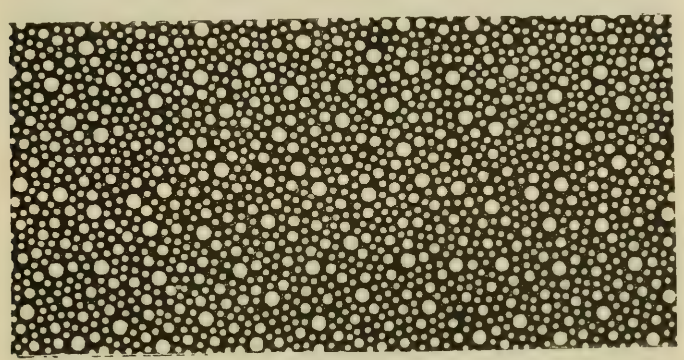


Fig. 233.

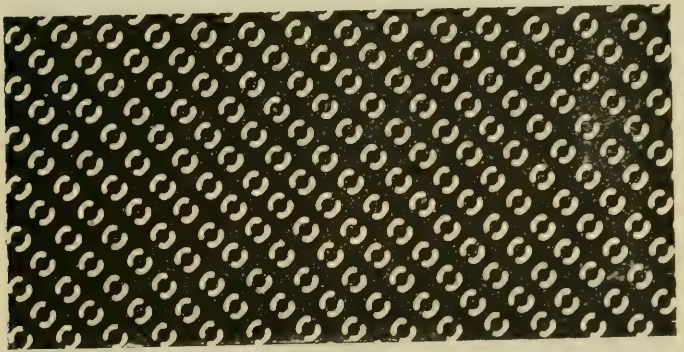


Fig. 234.
Circular Forms of Spotting.

spotted pattern. A striped style of effect is shown at Fig. 236, comprising the elements B in lines, and the effects A in small inverted fan shapes. Spotting forms, with the basic features constructed in circles, are illustrated in Fig. 237. On this principle the outlines may be devised on a geometric base, and the spotting lines or features may be alternately set across, as well as produced in lines differing in dimensions.

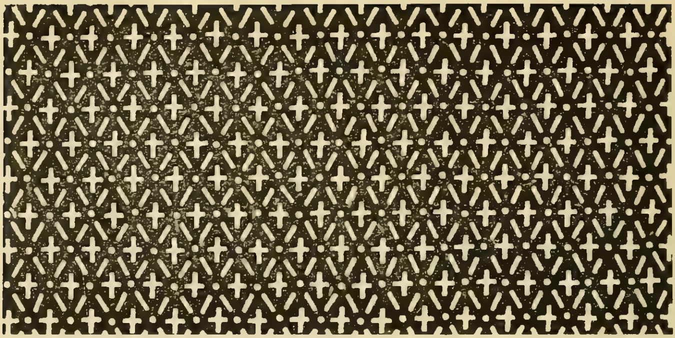


FIG. 235.

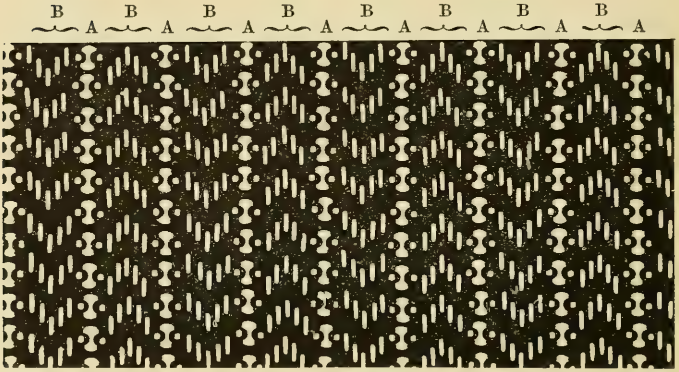


FIG. 236.

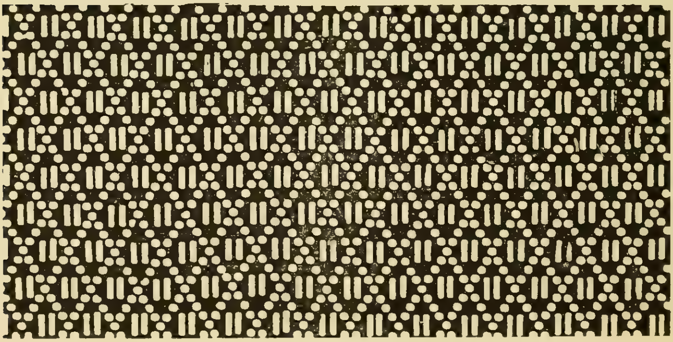


FIG. 237.

LINE- AND CIRCULAR-SPOTTED TYPES.

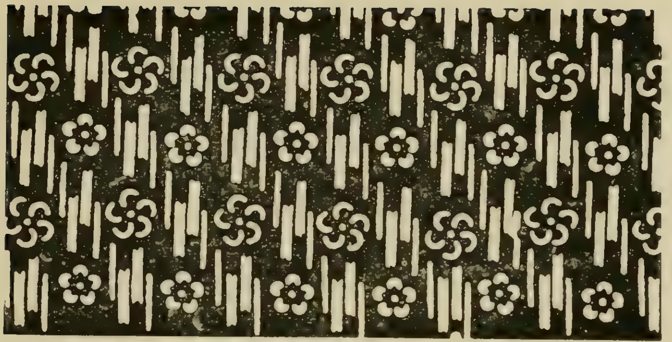


Fig. 238.

Fig. 239.

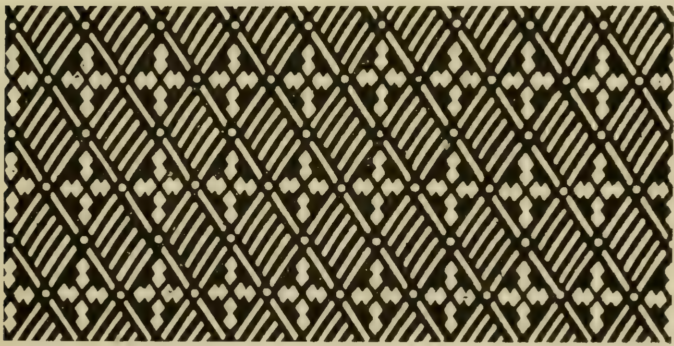


Fig. 240.

Rosette, Line, and Diamond Forms of Spotting.

The pattern scheme shown at Fig. 238 has been acquired by first sketching and grouping the effects in broader and in finer straight lines, and secondly, by adding the lesser rosette forms, with their elemental sections more pronounced than in the additional series of these forms. Combining triangular and quadrilateral motives, and spacing them in identical relation with each other, and then by joining these results, the spotted type of design seen in Fig. 239 is obtained. Here the central figures are planned on a checked base, so that the triangular elements interchange in position with the decorative units consisting of small conventional floral forms. In Fig. 240 an example is seen of the severer and set variety of spotting. Strictly, it is a lozenge pattern with vandyked cross-shaped figuring in contrast with elongated diamond forms developed in parallel lines, and also in contrast with the divisional lines making the basic plan of the style.

221. *Spotted Ground with Plain or Decorative Figuring.*—In the examples examined the groundwork has been plain, but in Figs. 241 and 242 it is of a spotted nature. In both these illustrations the ground sections consist of bird's-eye spotting, but in Fig. 241 T-shaped forms, and cross and rectangular details are combined; and in Fig. 242 small stars in pairs and in single units are distributed on a spotted surface. Further, in the first of these designs the figuring is worked in plain patches; while, in the second example, the figuring is due to insertion. Both are suggestive of standardized practices in spotted and mosaic designing, but the second principle gives the more varied type of structure in the woven fabric.

222. *Point-Paper Production of Spotted Designs.*—As showing the systems of looming feasible in the production of the different groups of spotted and detail patterns illustrated, and the weave units adaptable in transferring the sketches on to point-paper, examples in constructive data for Figs. 227 to 242 are given in Table XI—

TABLE XI

Methods of Plan Making Applicable to Spotted Styles

Fig. Nos.	*Weave Structure and Composition.*	*Point-Paper Design.*
227	(*a*) Plain weave ground with line details in ${}_{1}^{3}$ and ${}_{3}^{1}$ warp and weft twills	24 × 24, or 32 × 32
	(*b*) Sateen ground, with lines in weft twill . .	30 × 30, or 60 × 60
228	Similar to Fig. 227, also in prunelle twill ground and in ${}_{5}^{1}$ twill for line streaking or spotting .	48 × 48
229	(*a*) Stronger lines in ${}_{4}^{1}$ sateen, finer lines in ${}_{3}^{1}$ twill with plain ground	64 × 64
	(*b*) Stronger lines in ${}_{1}^{4}$ warp twill, finer lines in ${}_{2}^{1}$ weft twill, plain ground	96 × 96
230	Similar to Figs. 227 and 229.	
231	Transverse lines in weft twill, vertical lines in warp twill, plain ground	24 × 24, 32 × 32, or 48 × 48
232	(*a*) Triangular forms in weft twill, and circular spots in sateen, with plain ground . . .	48 × 48, or 64 × 64
	(*b*) Circular spots in plain, triangular spots in ${}_{3}^{1}$ broken twill, ground in ${}_{1}^{3}$ warp twill . .	ditto
233	(*a*) Small spots in weft floats, larger spots in weft sateen, ground plain	96 × 96
	(*b*) 5-shaft warp sateen ground, small spots in weft floats, larger spots in weft twill . . .	100 × 100
234	(*a*) Warp sateen ground, weft sateen or twill spotting	48 × 48
	(*b*) Plain ground, weft float spotting . . .	64 × 64
235	Intersecting diagonal lines in warp floats, circular spots in weft floats, star effects in weft sateen, ground plain	64 × 64
236	(*a*) Plain ground, line effects in ${}_{3}^{1}$ weft twill, detail figuring in sateen	72 × 72
	(*b*) Warp prunelle twill ground, line effects in weft prunelle, detail features in weft twills angled from the edges of the spottings . . .	96 × 96
237	(*a*) Plain ground, circular spots in warp, vertical lines in ${}_{3}^{1}$ weft twill	64 × 64
	(*b*) Sateen ground, circular spots in weft floats, vertical lines in weft sateens.	
238	(*a*) Thicker lines in weft twill, finer lines in plain, floral forms in weft effect, ground in ${}_{1}^{3}$ broken twill	96 × 96
	(*b*) Ground warp rib, finer lines in warp twill, thicker lines in weft twill, floral forms in adapted weave units	96 × 96, or 192 × 192
239	Triangular sections in twilled lines, following the direction of the pattern forms; circular features in sateen, with interior spots in weft floats; floral details in special weaves, plain ground.	
240	(*a*) Parallel lines in warp twill, basis lines in weft twill, diamond spotting in sateen, plain ground	64 × 64, or 72 × 72
	(*b*) Warp sateen ground, parallel lines in weft twill, basic lines in fine warp repp, stars in weft sateen.	
241	(*a*) Plain ground, spotting in floats of warp, figuring in weft sateen.	The sketches to be adapted to designs formable on 192 × 192
242	(*b*) For a double-plain make texture, colouring 1-and-1, ground and figuring being developed in one shade, and spotting in a second shade.	

From these data, it is clear: (1) that the weaving practice may be adapted to the manufacture of fabrics in which the design is a product of the weft, warp, or both the warp and weft yarns; and (2) that it may be made to impart freshness and diversity of character to the simpler as to the more varied

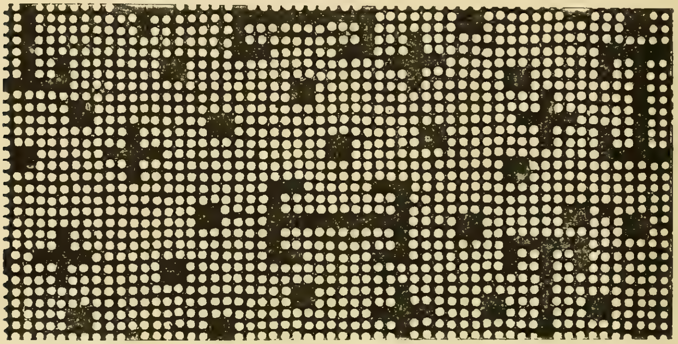


FIG. 241.

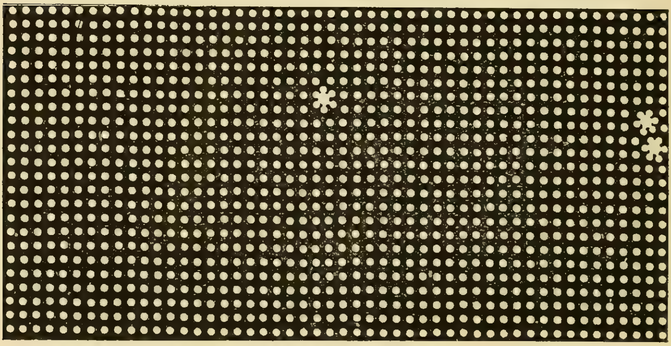


FIG. 242.

PATTERNS WITH A SPOTTED GROUND.

descriptions of spotting. Printing the design on the goods leaves the decorative type in the same textural effect as the ground, whereas the process of weaving them into the fabric, enables the line features, and each kind of pattern detail, to be developed in a different species of woven surface.

223. *Figuring in Spotted Minutiae.*—It should, however, be noted that spotted goods, in which the figuring consists of

decorative details, are extensively acquired by printing. Many styles of this class of ornamentation are therefore applied to the cloths, after weaving, as in blouse and dress materials, and in silk foulards, etc. Styles of pattern specially suitable for this treatment are shown in Figs. 243,

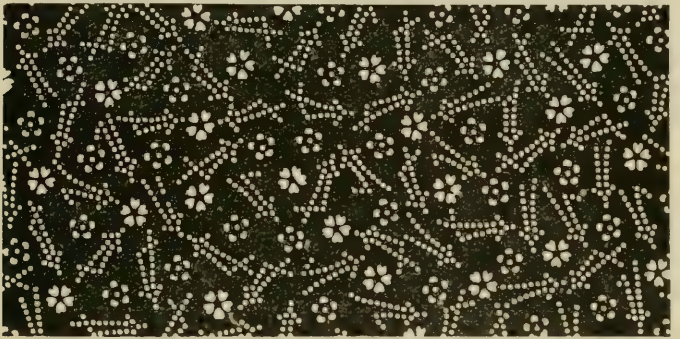


FIG. 243.

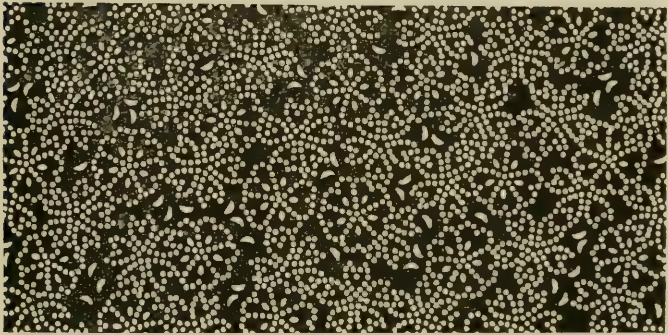


FIG. 244.

DECORATIVE STYLES IN SPOTTED MINUTIAE.

244, and 244A, B, and C. However fine the counts of the yarn employed, and closely set a texture may be woven, these extreme minutiae in decorative composition and planning are more accurately reproduced by the art of printing than by the art of warp and weft intersection. But such examples are not on that account to be assumed as wanting in textural suggestiveness and interest. They are valuable as pattern

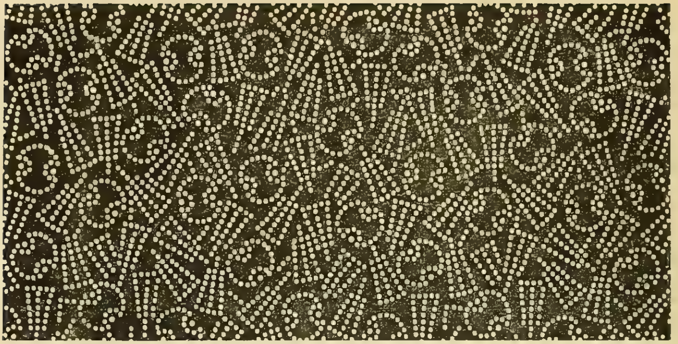


Fig. 244a.

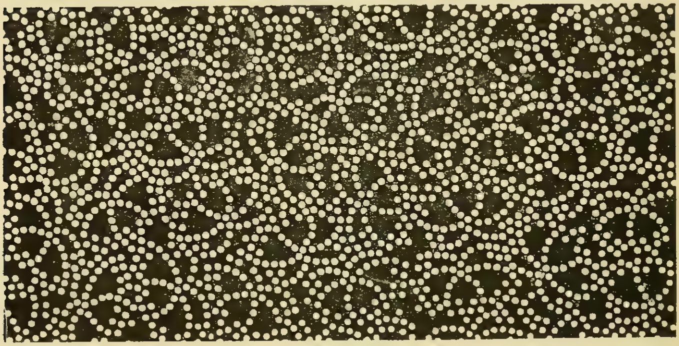


Fig. 244b.

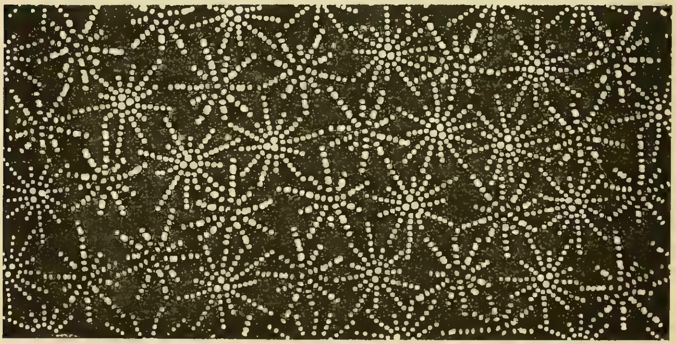


Fig. 244c.

Decorative Styles in Spotted Minutiae.

schemes in which the figured features are formed in dots, specks, streaks, and other small effects, and in which the form structures are delineated without contrasts due to line emphasis and demarcation, or contrasts due to tone shading. Further, they are also useful as schemes of design construction applicable, in a correct scale, and when simplified in detail arrangement, to point-paper draughting. Thus, in Figs. 243, 244, and 244A, B, and C, the varied filigree ornamentation they comprise is transferable into textile productions by working out the looming designs on the lines indicated below—

FIG. 243.—WEFT FIGURING, COTTON WARP, AND SILK OR LUSTRE YARN WEFT

Size of design 192 × 192.—Developing the small floral patterns in weft-face twills, agreeing in direction with the form features, and the filigree effects in circular spots in solid floats of weft, with a plain make for the ground of the fabric.

FIGS. 244, 244A, B, AND C.—SILK WARP AND WEFT

Similar types of pattern to these examples are producible in a 300 or a 400 Jacquard machine, with the designs in two tints of weft yarn, shuttled pick and pick, and using one weft in developing the smaller, and the second weft in developing the more pronounced details—each weft floating solid for figuring, and intersecting in regular order with the warp for producing the ground.

It will be understood that the methods of looming described in Table XI for Figs. 227 to 242 inclusive, require to be varied with the quality and counts of the yarn employed. While therefore the instructions, tabulated for working out the patterns on point paper, would result in correct schemes of textural design, in the application of such data to the fabric they are necessarily modified by the nature and class of the goods manufactured.

224. *Weaving Principles in Producing Spotted Patterns.*—The principles of intertexture applied in producing spotted and mosaic styles of pattern include looming practices in which the effects are obtained—

(*a*) In the weft.

(*b*) In the warp.

(*c*) In the warp and weft.
(*d*) In extra or supplementary weft yarns.
(*e*) In extra or supplementary warp yarns.
(*f*) In both supplementary warp and weft yarns.
(*g*) By colour arrangement in single and compound-fabric structures.

These may be studied and dissected under the serial groups of fabrics and design types described in Table XII—

TABLE XII

VARIETIES OF SPOTTING AND MOSAIC PATTERN DESIGNING

Classes.	*Methods of Spotting.*	*Manufacturing Practices.*
1	Warp weave ground, weft spotted or weft pattern development.	Worsted, cotton, or silk warp with similar yarns for weft, e.g. cotton warp crossed with silk, or worsted warp crossed with mohair or silk alpaca, etc.
2	Weft weave ground, warp spotted or warp pattern devolopment.	Cotton warp in ground, with special warp threads inserted for spotted sections, and with lustre worsted, alpaca, etc., for weft.
3	Plain or twill ground, weft, warp, or both warp and weft spotted.	Cotton, silk, worsted, or linen warp and weft, or cotton warp crossed with different counts and quality of weft.
4	Extra or supplementary weft spotting.	Applied in different varieties of single-make dress and blouse textures.
5	Extra warp spotting	ditto ditto
6	Extra or supplementary warp and weft spotting.	ditto ditto
7	Single simple-make fabrics, with the spotting developed by weave and colour assortment.	Applied in cotton, silk, linen, worsted or woollen fabric construction.
8	Compound-make fabrics, with the spotting developed by weave and colour assortment.	ditto ditto
9	Compound - make fabrics, spotted with extra yarns.	ditto ditto

225. *Warp, Weft, and Warp-and-Weft Principles.*—These principles of design are suggested in Figs. 245, 246, 247, and 248. Employing warp-face weaves (e.g. sateen or twill) for the ground, as in Fig. 245, provides for detail pattern production by floating the picks of weft in any regular order in the

spotted sections; while for developing the effects in warp threads, the ground weave is changed to a weft-face plan, and the spottings are formed in warp floats as in Fig. 246. If the two schemes are combined, the ground plan should be of a plain weave, simple twill, or of a mat character, that is a weave which floats the warp and weft evenly and equally on both sides of the texture. In using the plain make for ground purposes, the spottings are acquired on the basis of construction seen at Fig. 247, and in employing the $\frac{2}{2}$ twill in the ground the spottings are formed as indicated in Fig. 248. In both these illustrations the warp ingredients are printed in ⊠'s and the weft ingredients in ■'s and in ⊡'s.

□'s = Warp.

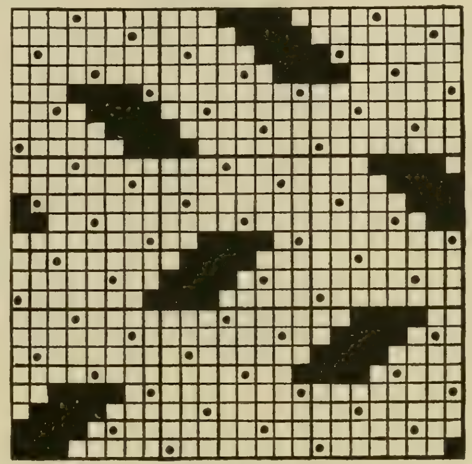


FIG. 245.

□'s and ⊠'s = Warp.

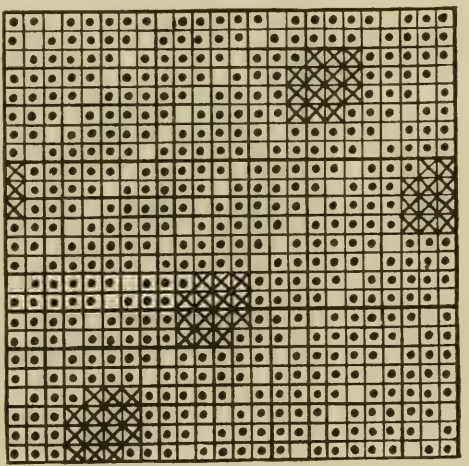


FIG. 246.

WEFT AND WARP SPOTTED PLANS.

226. *Lustre and Silk Weft Spotted Designing.*—The weft scheme of spotted pattern

's and 's = Warp.

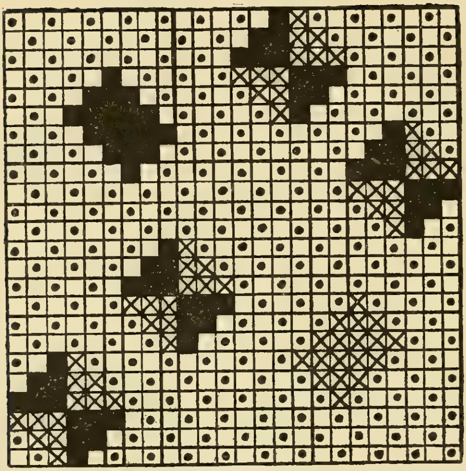


FIG. 247.

's and 's = Warp.

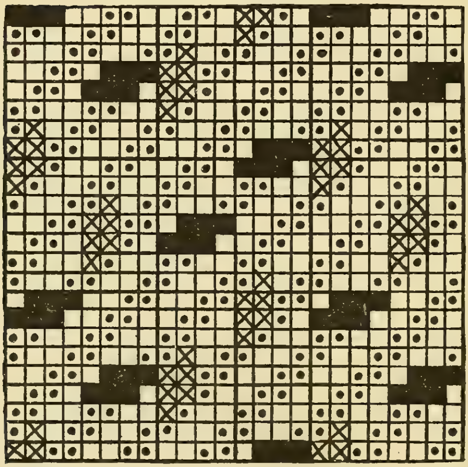


FIG. 248.

WARP, WEFT, AND WARP-AND-WEFT SPOTTED PLANS.

origination is, in the first place, applied to lustre or silk weft and cotton warp textures, and also to pure cotton goods. The designs have almost invariably a plain ground, which provides for the pattern features being woven in different weave structures. Fig. 249 is a typical Jacquard style, and consists of a series of decorative elements in $\frac{1}{3}$ twill, and of a second series in $\frac{1}{7}$ twill. Variety of effect in the cloth is obtained by the two types of weave used in relation to the distinctive forms of spotting of which the design is composed. As prominence is given to the weft yarn in such plan-making, the build of the texture as well as the pattern scheme, develop satisfactorily in manufactures of the *glacé* quality, and also in cotton zephyrs. In originating such styles of pattern, the first work should be to devise and group the principal spottings selected, combining those which harmonize in structural form ; and, second, the arrangement and distribution of the figures should be determined, two factors which are affected by the relative dimensions of the several motives employed.

227. *Weft Spotting—Diversified Weave Grounds.*—In the next place, for more varied classes of fabrication, different kinds of ground weaves are used, particularly such as agree with the style of spotted figuring and the make of fabric required. One object of this constructive principle is to employ a warp yarn which, in quality and tint, may be made to contrast with the pattern features expressed in the weft yarn. Whether the warp appears in the figuring or simply in the ground, it is thus rendered effective in imparting tone to the style. Two examples are given in Figs. 250 and 251, in which the warp is not a decorative unit, being concealed in the spottings by the picks of weft, but in the third example, Fig. 252, the warp assists in delineating the design form.

In Fig. 250, the spotted features are severe in tone and character ; but the weaves combined are of such a formation that whether the design is produced in cotton, silk, worsted or woollen yarns, it yields a neat, level cloth, and also one

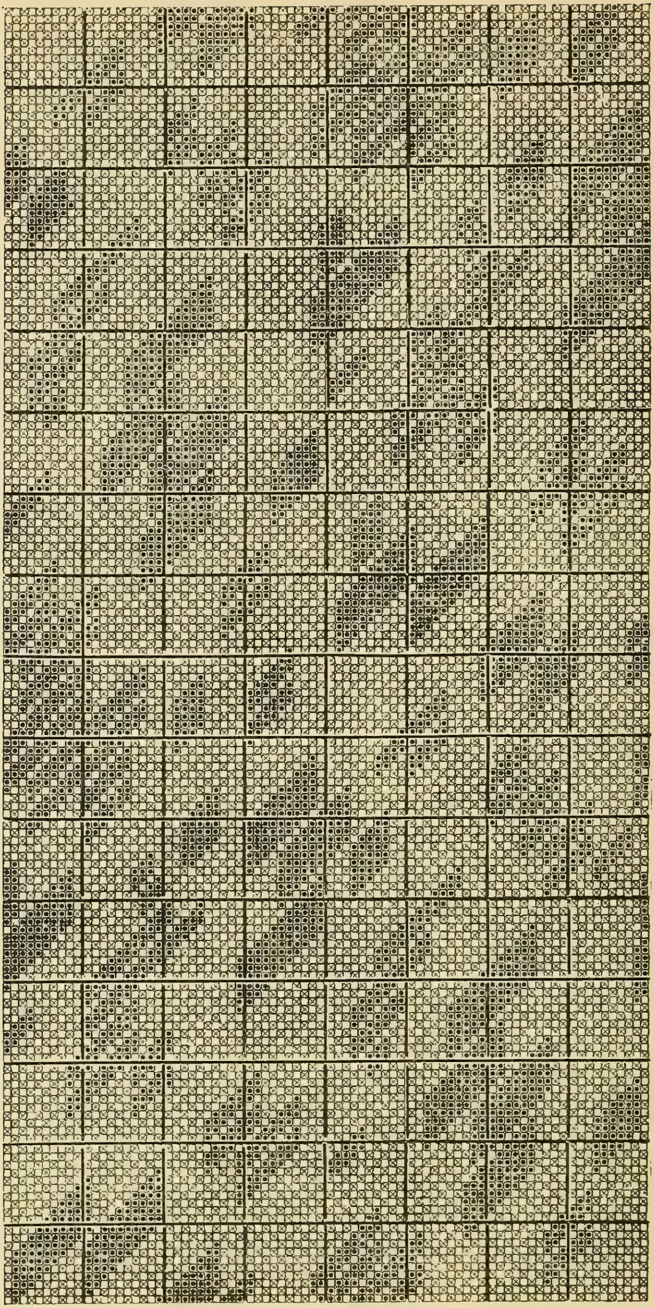


FIG. 249.—WEFT SPOTTING ON A PLAIN GROUND: ZEPHYR OR LUSTRE.

diversified in constructive detail. Of the several methods of producing this style in the woven manufacture, three may be described. Considered in relation to cottons or silks, it is weavable, in the first instance, in one colour of warp and weft; and, in the second place, by the insertion of fancy threads into the warp and by the use of a contrasting colour of weft yarn, or on the following lines—

Warp.

4 threads of a light shade cotton (2/50's) or silk (50's/2).
40 ,, ,, very light ,, ,, ,, ,,
4 ,, ,, light shade ,, ,, ,, ,,

Weft.

A third shade (25's cotton, spun silk or art. silk) contrasting equally in depth of tone, and in hue, with the two shades in the warp.

The result of this order of colouring would be to give the star figures in a distinct shade, namely, that of the weft; the light threads in the warp would stripe the edging of the spottings, and the very light shade would form the ground or circular shape in which the star features occur.

Third, a design of this regular construction is also weavable in worsted and woollen yarns. For the former, two practices in manufacture might be adopted—

(1) *Warp and Weft.*

2/60's worsted light shade.
,, ,, medium shade.
64 threads and 60 picks per inch.

(2) *Warp and Weft.*

1 thread of 2/72's worsted mixture.
1 ,, ,, ,, ,, ,, darker tone.
78 threads and 74 picks per inch.

If applied to woollen costume cloths, the yarns should be about 32 skeins with a lighter shade in the warp than that used in the weft, and with 36 threads and 34 picks per inch.

Analysing Fig. 251, the larger star spottings are centrally placed, one opposite the other. The grouping of the two sorts of motive combined, is on the 6-end sateen base, hence the balance of figure distribution here observed. The design

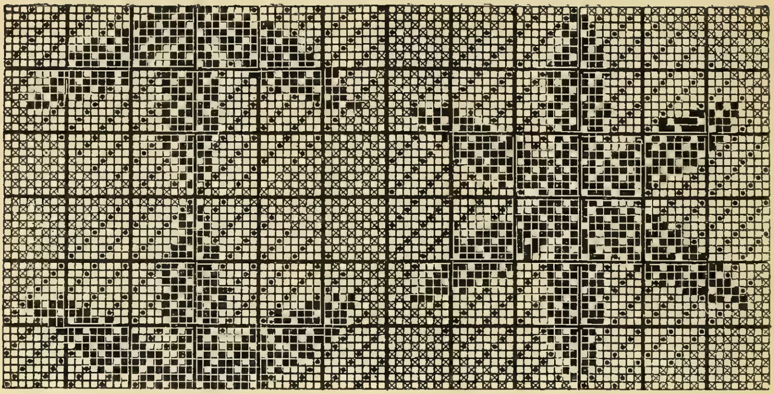


Fig. 250.—Pattern Development in 4-Shaft Weaves.

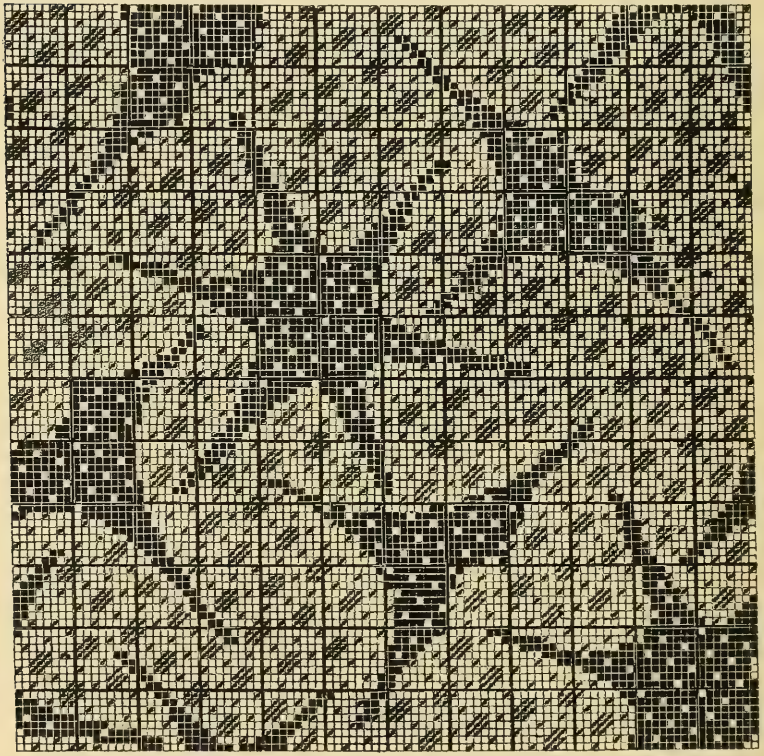


Fig. 251.
Star Spotting in 8-Shaft Sateen on a Mottled Ground.

features are developed in weft sateen, but the two central spottings might also be woven in weft twill. The ground is a derivative of the 8-shaft sateen due to extending it to 16 threads and picks. It fits correctly with the weft sateen applied to the figured details. The ordinary warp sateen would give the necessary levelness of fabric surface, and definition of pattern, but it would be less efficient in textural effect as compared with this plan, the small weft spots in which add to the tone of the ground work of the fabric.

228. *Utility of Cross-Colourings.*—The utility of the warp yarn in giving design characteristics—in addition to the

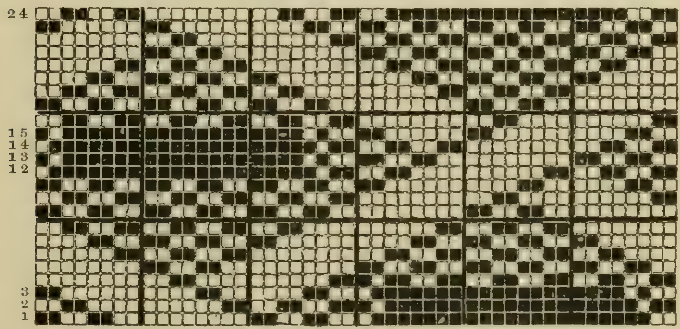


FIG. 252.—FLOATED WEFT SPOTTING.

features due to the figuring in these two specimens, Figs. 250 and 251—will be understood by assuming the warp to be a light tint, and the weft a deeper colour. For either cottons or silks, this degree of contrast of shade in warp and weft is an advantage, as it defines the figuring and lends clearness to the detail in the different parts of the design. Still, for certain cotton and worsted textures, the soft quality of figured expression which results when only one shade of yarn is used, is a desirable characteristic of the fabric. Especially is this the case in worsteds, where the finishing routine develops the constructive features of designs in which there is a diversity of warp and weft effects ; as, for example, in the warp-twill ground in Fig. 250, and in the fancy sateen

ground in Fig. 251, both of which would possess a distinct tone in the finished cloth from the pattern elements composed of the weft yarn. When a contrast in the materials of which the yarn consist is also allowed, the respective details of the style are further enhanced. Thus, supposing the warp to be fine worsted and the weft mohair or silk, then the ground of the texture would be in a dull, and the figuring in a lustrous, quality of yarn. Another practice, in the lighter varieties of

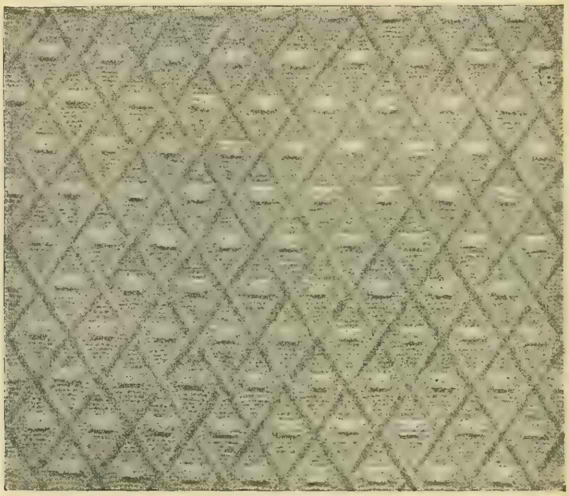


Fig. 252a.

fabric, is to employ a cotton or linen warp, and cross with a silk or artificial silk weft.

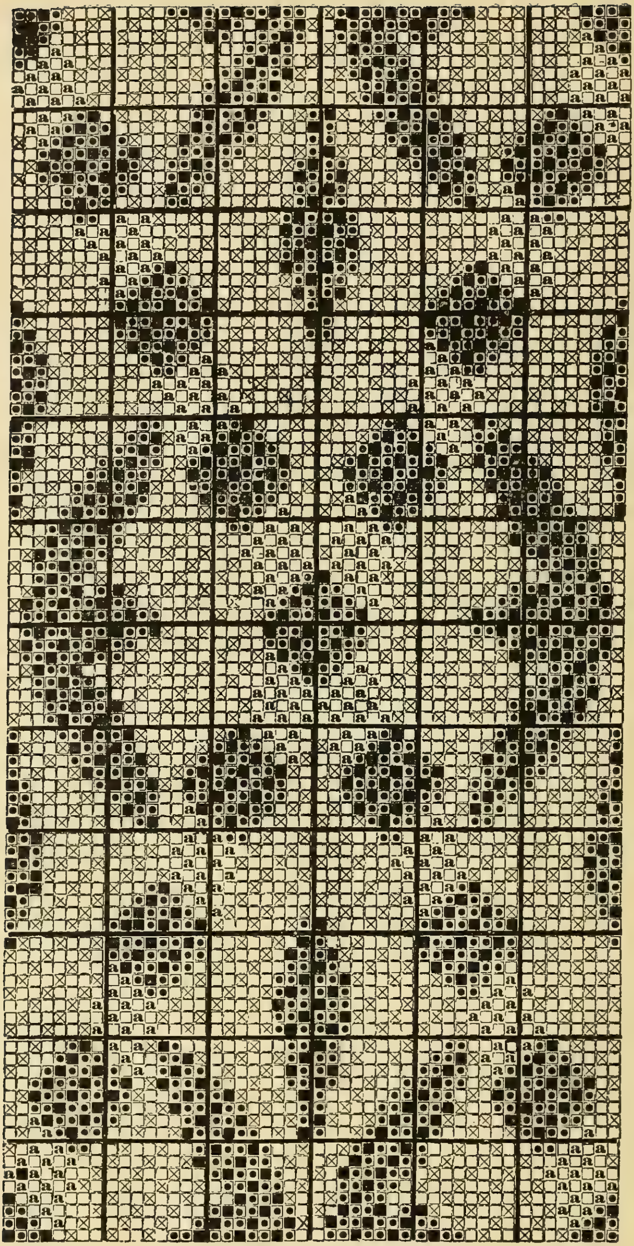
Spotted types are also made on fast woven grounds in which special design sections are developed in the threads of the warp. Taking a simple illustration, that in Fig. 252, it is formed of weft cord and intersecting diagonal lines in floats of warp, with the spottings in loose flushes of weft. As the latter are unknitted into the cloth, they show prominently on the surface, protruding in minute patches as observed in the woven specimen, Fig. 252a. Such designs should be firmly set in the warp, but less closely wefted, allowing for

the production of a firm, fast structure, with the employment of a thicker counts of weft than warp yarn, and a smaller number of picks than threads per inch. The specimen has been produced in 2/60's mercerized cotton warp and 15's weft, having 130 threads and 52 shots per inch. For emphasizing the spotted lines, the picks—1, 2, 3, and 24, and 12, 13, 14, and 15—forming these should be in silk.

229. *Mosaic Patterns in Several Weave Units.*—Theoretically, designs constructed for developing the effects in the weft, when inverted are usable for developing such effects in the warp. This practice in designing is applicable to styles of pattern due to combining warp and weft face weaves, one weave applied to the ground, and the second weave to the figured or spotted sections. Examples thus constructed are given at Figs. 253 and 254, with a third example—Fig. 255—in which the ground is warp rib, and in which the detail effects are in graduated weft cords. They are illustrative of different systems of pattern construction, and will be separately examined.

Fig. 253 is a compound of star and festoon spotting, the latter features being linked with each other by details in plain weave. Should the design be applied as illustrated, the figuring would be in weft, but should the order of looming preparation be reversed, that is, □'s taken as weft, and the ⊡'s taken as warp intersections, it would give the pattern types in warp, and the ground of the texture in weft twill. Various practices in textural development are feasible in the weaving of designs of this class. In the first instance, they are made in piece-dye cloths; in the second, in fabrics in which the warp and weft yarns differ in colour; and, in the third instance, the standard orders of warping and wefting applied to the prunelle twill are suitable, such as the 2-and-1, and the 1, 1-and-1, both of which would develop the ground in lines of colour.

230. *Warp-Twill Ground adapted to Weft-Twill Spotting.*—Fig. 254 is producible, like Fig. 253, either as a warp or as a



Lift □*'s and* ■*'s.*

FIG. 253.—WEFT PRUNELLE PATTERN: LOZENGE BASE.

weft-spotted style. An advantage, in developing the effects in the weft, is the readiness with which the colour quality of the

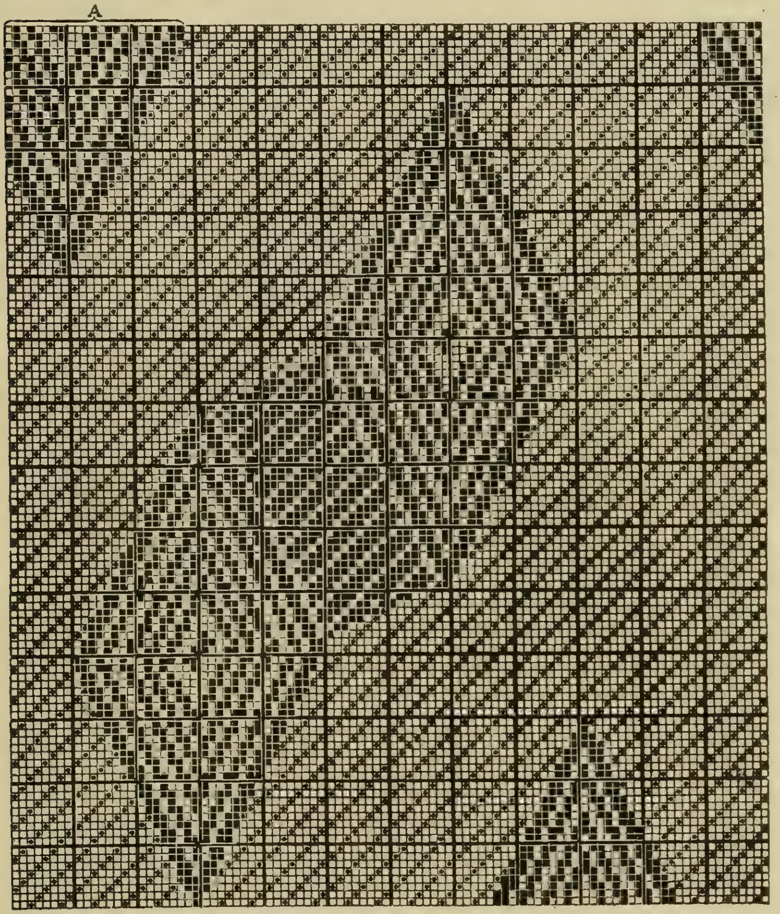


Fig. 254 (*Section only*).
Spotting in Special Weaves on a Warp-Twill Ground: Drop Base.

texture may be changed. If, however, the object is a piece-dye manufacture, then the warp principle of delineating the figured types might be selected. The two characteristics of this style—Fig. 254—are the adaptation of the weave structure

to the lines of the lozenge shapes, and the unity of pattern detail derived by linking these shapes together by the parallelogram forms in weft twill. The design, as printed, has a warp ground, with the figures in weaves of a weft-flush character. The upright twills combined, following the outlines of the figuring, yield diamond spots decreasing in size from the outside to the inside of the figure. For varying the ground, two systems of work may be followed—first, it may be

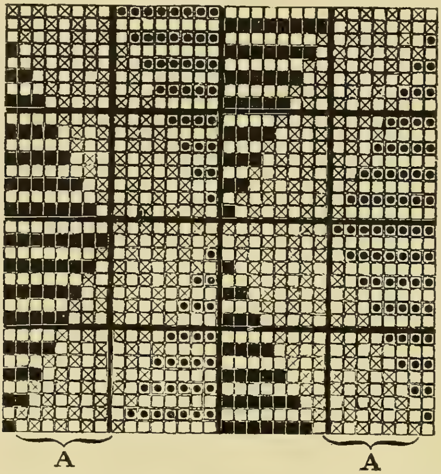


Fig. 255.
Warp-and-Weft Cord Spotted Effect: Diamond Base.

coloured 2-and-2 in the warp and weft, giving line stripings; and, second, small weft spots arranged on a sateen or similar base, may be inserted on the principle defined in reference to Fig. 251. Assuming the first practice to be adopted, and the colours to be blue and white, a texture would be produced in which the groundwork would consist of lines in these two colours, while the rhomboidal spottings would be woven in transverse lines, and the lozenge spottings defined in intermingled colouring. The use of simple weave units, as indicated in regard to Fig. 253, renders the standard orders of warping and wefting applicable to such weaves, adapted to both the

ground and figured portions of these designs, with the use of either woollen or worsted yarns. Hence this illustration—Fig. 254—may be appropriately coloured 2-and-2, 1-and-1, and 2-1-and-1. In the case of the first arrangement, it would cause the ground to be developed in vertical, and the small rhomboidal forms in transverse lines in the two shades of yarn employed, with the lozenge spottings in a melange tone of colour. A subdued quality of figured expression is thus acquired with the ground in line striping. Should the $\frac{3}{1}$ twill be modified by the insertion of specks of weft arranged on a 24-end sateen base, it would give the figuring, when woven in one colour of warp, and in a second colour of weft, clearly outlined, and the ground in a decorative warp twill.

Applying the example to cotton and linen goods, should the $\frac{3}{1}$ twill be changed to the plain weave or warp rib, a coloured striping might be run underneath the figuring, on some such plan as shown below—

Warps.

I.	White . . .	8	12	16	12	8
	Lavender . .	8	8	8	8	8
II.	Fawn . . .	10	10	4		
	White . . .	4	10	10		

Wefts.

For the first order of warping, to be rose colour, and for the second order, light blue, or French grey.

By using these wefts, the pattern resulting from the former colouring, would be a shaded striping, on which the spotted figuring would be distributed in the rose colour, but that resulting from the second order would consist of definite bands of colour in white and fawn, with the figuring in light blue.

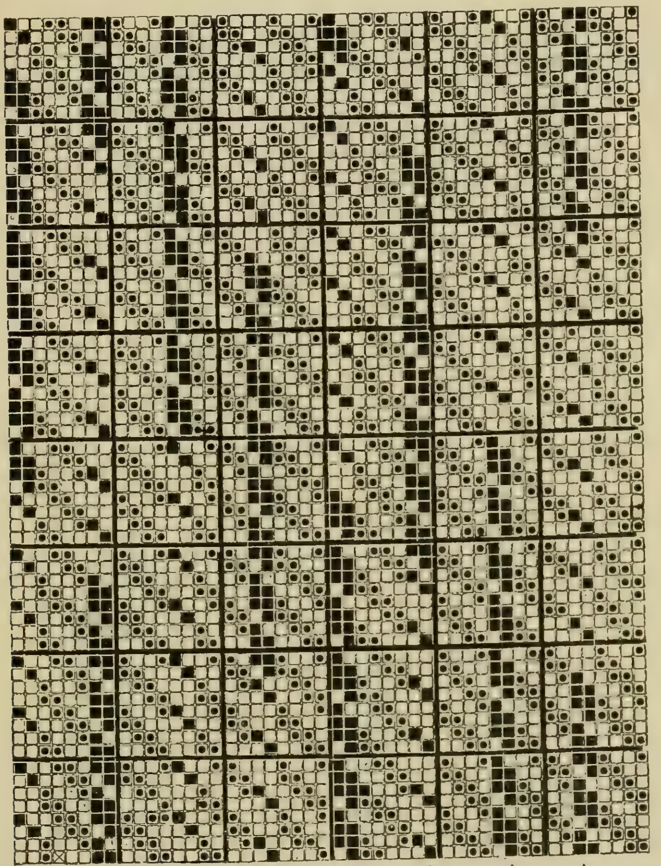
231. *Ribbed Ground and Warp and Weft Detail.*—The repp or ribbed ground is particularly suitable for firmly-set fabrics in which the decorative details are developed in the weft or in the warp yarn. If the weft should be employed for spotting, then the designs may be constructed on the system seen at

Fig. 255. But should the warp be used for this purpose, and a similar type of spotted effect be intended, the designs would be changed to a weft rib in the ground with warp cords in the figured sections. For the first of these methods of construction, the example is weavable in 2/80's cotton or 80's two-fold silk with 36's weft, and with 96 threads and 80 picks per inch, and in proportionate settings with the increase or decrease in the counts of the yarn applied. The design, as illustrated, admits of the use of a thicker and distinct kind of yarn in the shuttling than in the warping; but in acquiring pattern development on the warp principle, it is essential that the warp should be two-fold, and the cloths be built closer in the reeding than in the shots per inch.

The example is an elementary form of geometric spotting. The ground sections, between the repeats of the pattern details, may be varied, as also the character and type of the spots. But if a cord or repp plan of fabric structure is desired, ribbed weave units should be selected, but modified in the length of the weft intersections to make them consistent with the accurate and precise definition of the spotting details. Colouring Fig. 255 1-and-1 in two shades of weft (and in two shades of warp should the plan be inverted) gives the features in ■'s in a different colour from those printed in ⊡'s, with the effects in the warp or weft yarn in one or more tints as required.

232. *Spotting in both Warp and Weft Intersections.*—Should the spotted characteristics be woven in both warp and weft intersections, the weaves employed in the ground of the texture should equally accentuate the effects produced in each yarn unit, as, for example, in Figs. 256, 257, and 258; or the warp spottings should be developed on a weft-woven surface, and the weft-spottings on a warp-woven surface as in Figs. 259 and 260. The first of these systems of design is commonly practised in dress textures, with a plain, twill, or rib ground, each of which is effective in clearly defining the textural ornament developed in the weft as in the warp yarn. Considering

the line spot pattern—Fig. 256—the $\frac{2}{2}$ twill enforces the streaked details due to both the $\frac{3}{1}$ and the $\frac{1}{3}$ twills, and also fits correctly with each plan. This line variety of double



A A A A A A A A

FIG. 256.—LINE SPOTTING ON $\frac{2}{2}$ TWILL GROUND.

spotting is applied to rectangular as well as to striped patterns, and is also produced in $\frac{5}{1}$ and $\frac{1}{5}$ sateens or twills, with the prunelles weave for the groundwork; or the plain make may be used for the ground with either the ordinary or broken 4-shaft warp and weft twills in the spotted elements. This

description of design is weavable in worsted and woollen yarns, applying twist or fancy threads to sections A—Fig. 256—as indicated in the schemes of manufacture appended—

I.—Worsted Costumes

Warp.

2	threads	of	2/48's	light	mixture.
4	,,	,,	,,	medium	,,

Weft.

24's medium mixture, but in a different tone to the medium shade in the warp.

II.—Woollen Tweed Costumes

Warp.

2	threads	of	18 skeins	fancy mixture (1).
4	,,	,,	,,	mixture ground shade.
2	,,	,,	,,	fancy mixture (2).
4	,,	,,	,,	mixture ground shade.
2	,,	,,	,,	fancy mixture (3).
4	,,	,,	,,	mixture ground shade.

Weft.

16 skeins mixture ground shade.

III.—Cotton and Worsted Union

Warp.

2	threads	of	2/40's	cotton,	fancy	colour	(1).
4	,,	,,	,,	,,	ground	,,	
2	,,	,,	,,	,,	fancy	,,	(2).
4	,,	,,	,,	,,	ground	,,	

Weft.

24's worsted, matching the ground shade in the warp.

Scheme II is arranged to distribute the light mixture yarns successively on each group of spotting threads in the repetitions of the design, but in Scheme III, the order of the fancy colourings—tallying with the number of sets of the spotting threads in the pattern—would systematically tint the first, fourth, seventh, etc., pairs of threads A in fancy shade (1); the second, fifth, eighth, etc., pairs of threads A in fancy shade (2); and the third, sixth, first, etc., pairs of threads A in fancy shade (3). Each of these systems of colouring is utilized in the several makes and grades of light-fabric manufacture.

233. *Warp and Weft Spotting on Balanced Weave Grounds.*—In the first place, an illustration of this class of looming may be examined in which the plain make is used in the ground,

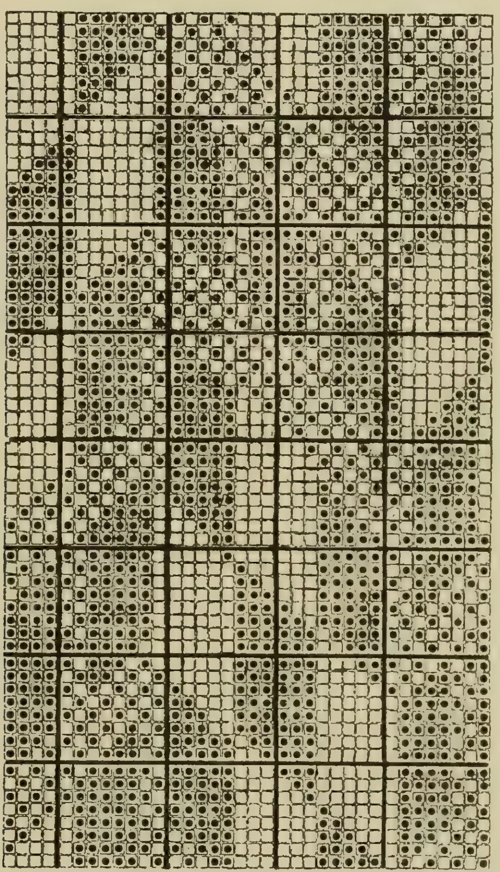


Fig. 257.—Mosaic Spotting in Warp and Weft Details.

and in which the spottings—Fig. 257—are produced alternately in warp and weft floats with certain pronounced effects in weft intersections, and divided from each other by plain interlacing threads. The idea in this constructive scheme is to approximately balance the two sorts of detail, and to

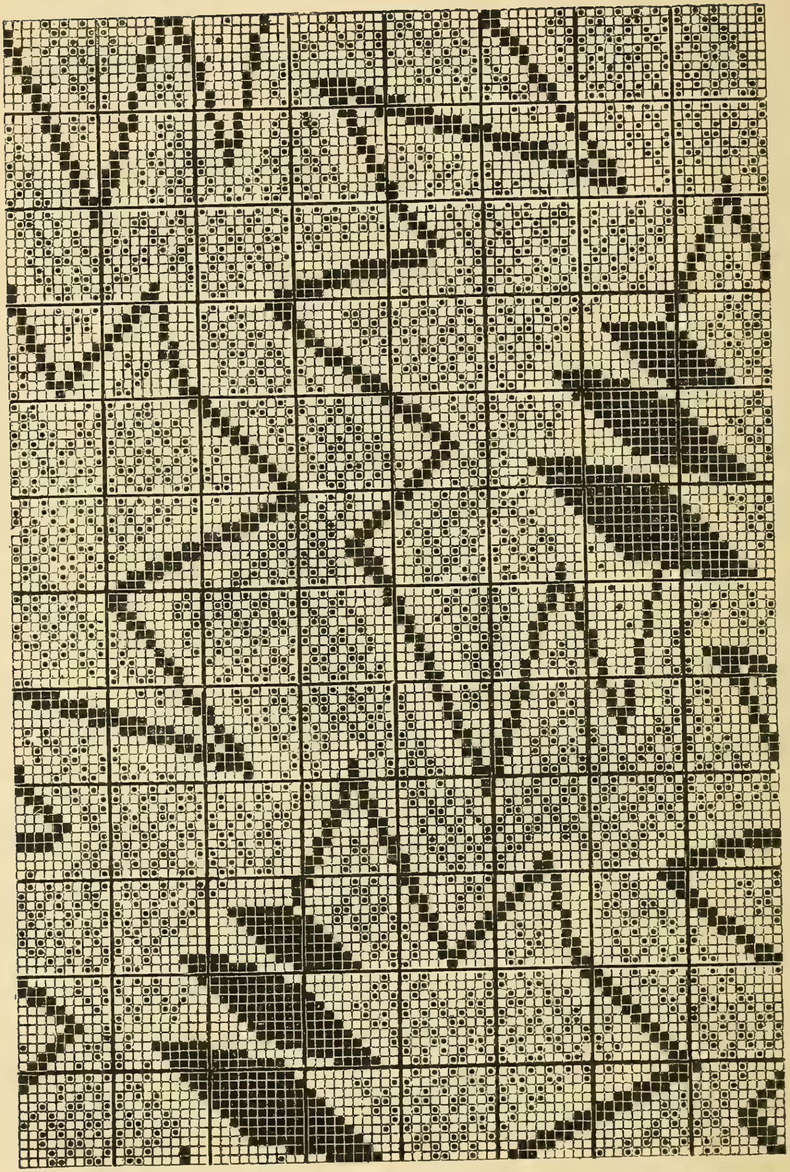


FIG. 258.
IRREGULAR-SHAPED SPOTTING ON A CREPE-WEAVE GROUND.

develop the distinctive lines of the pattern composed of either warp or weft floats. The spotted features are formed in regular or irregular shapes, for which sectional parts of diamond, diaper, twill, and other characteristic crossings are well adapted. In Fig. 257, portions of broad twills have been combined. This method of spot distribution is also usable in larger scale designs, and with the pattern features produced in diamond, lozenge, and other motives.

Mottled grounds are obtainable in weaves of the mock leno and minute check category, as well as in broken and cutting

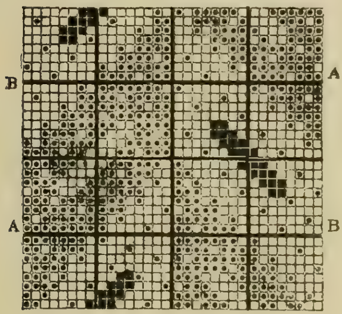


Fig. 259.—Transposed Spotting.

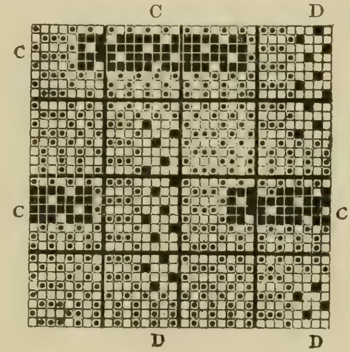


Fig. 260.—Sateen-weave Details on Cord Structures.

twills as in Fig. 258, a nondescript but symmetrical species of spotted design. The uneven, rectangular forms are here outlined in weft interlacings on a warp-flushed surface, with well defined effects in floats of weft arranged and grouped in agreement with the variety of spotting detail, making the distinctive sections of the style. The figured basis, in originating this class of pattern is first outlined, and developed in weft twills following the constructive lines. The possible dimensions of the warp flushes, on either side of the twilled sections, are, in the second place, marked out on point paper, and the special spotted features subsequently inserted. In running the ground weave on to the looming plan, it is made

to fit with the weft effects, and also with the pattern developed in flushed threads of warp. While a severe and sharp definition of the different forms should be avoided, the character and composition of the design require to be neatly and clearly expressed in the fabric, or on the principle of construction observed in this example.

234. *Spotting of Warp and Weft Surfaces.*—Sateen, diamond, and twilled weaves, having a warp or weft surface, are combined on geometric and other bases, and then spotted with simple motives or small figured details. Figs. 259 and 260 are illustrative of this practice. The former is composed of 8-end sateen weaves, having the sections A and B grouped in a striped relation, with *weft* spottings—marked in ■'s—on the warp-face plan, and *warp* spottings—marked in □'s—on the weft-face plan. The two weaves are used in check, diaper, and in various pattern schemes, and the spots are distributed on a sateen or other mathematical arrangement; or twilled weaves, the reverse of each other in warp and weft intersections, are employed. But, whichever system is followed, in this description of weave compound, the practice of producing the spotted units in *warp* effect on a weft-face, and in *weft* effect on a warp-face crossing, is strictly adhered to. Textures of another class—Fig. 260—are acquired by developing the spottings in "face weaves" on a suitable ground. Here it will be noted that the spots C and D are woven in 5-end warp and weft sateens. The effects D are lined at the edges with weft cord, and effects C with warp-cord, with plain binding or knitting threads and picks for delineating and clearly defining the spotted motives. The cord weaves have in such instances a two-fold application, for they first present each kind of spot on a textural surface differing in structure and thread development from that in which the spotted sections are woven; and, second, they produce in the ground of the fabric a pattern type in complete unison with the plan of the spotted effects. The example may therefore be regarded as illustrative of the spotted basis

in which the ground weaves are adapted in method of combination, and also in warp and weft-face features, to the structural principle of grouping the detail elements of the pattern.

235. *Mosaic Patterns—Curvilinear Variety.*—These are as varied, and as multiform in plan and composition, as designs devised on geometric bases. Their mosaic characteristics are also similarly diversified and commingled, with the effects interchangeable as in the latter.

It is primarily fundamental that the curvilinear figuring should be effectively drafted on point paper, the form and shape of the curved decorative types being smartly defined by the order of the movement of the warp and weft intersections in which they are produced.

The scheme of design work will be described by referring to Figs. 261, 262, and 263—examples in which the figured sections consist of circular and curved outlines. Fig. 261 consists of two equal arcs of circles joined together, and two similar arcs, so combined as to give the central diamond effects marked in ☒'s. The figuring, printed in grey, would, in the texture, be sateen woven. Repeating the style exhibits the scheme of arrangement more clearly than in the illustration. Though each of the circular forms is worked out on 40 threads and 40 picks, the plan of the intersections results in the different form types being as neatly curved in the fabric as if instrument drawn. When the exact pattern structure has been thus produced, the manner in which it is treated, as to weave detail, may improve or detract from its textile application. Analysing the example, it will be seen that the several weaves of which it is formed are planned and intermingled with the object of making each section of the design interesting and distinct in textural character. In constructing patterns of this class, the figuring requires to be accurately moulded, but it is also necessary that the woven fabric should be level and well-built, and diversified in weave composition. The specimen enforces these principles of design and cloth structure. First, the crescent forms are developed

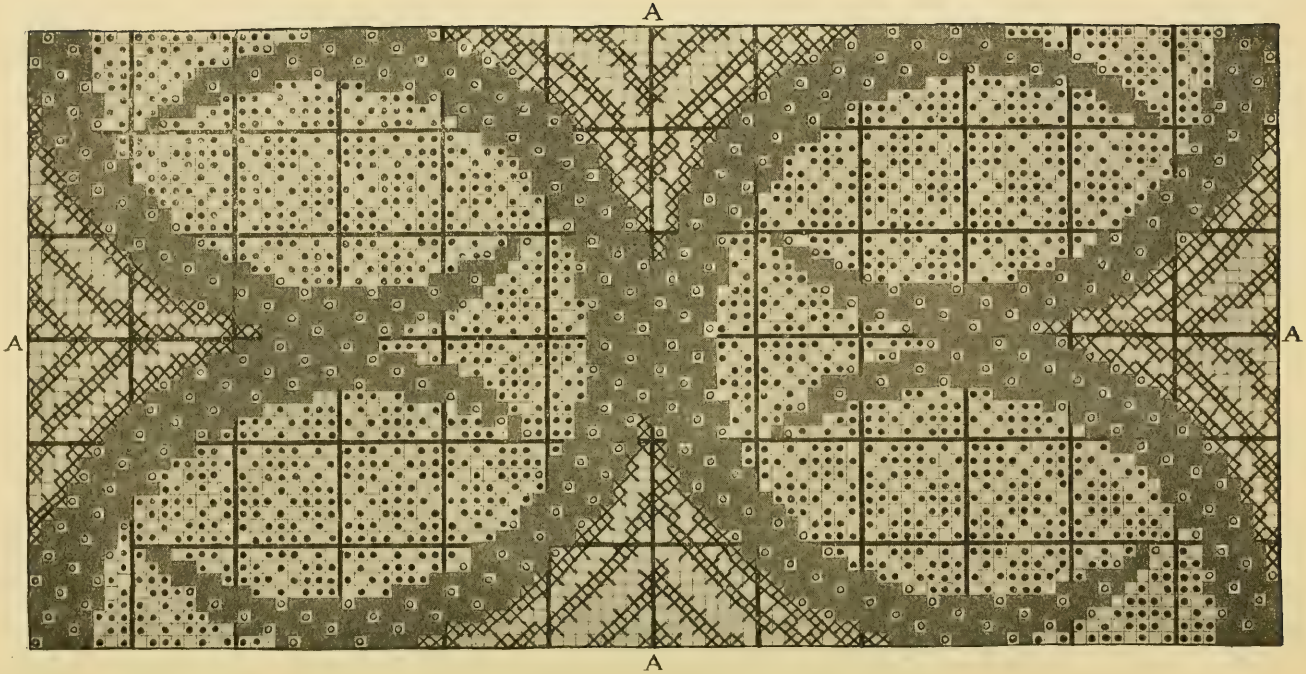
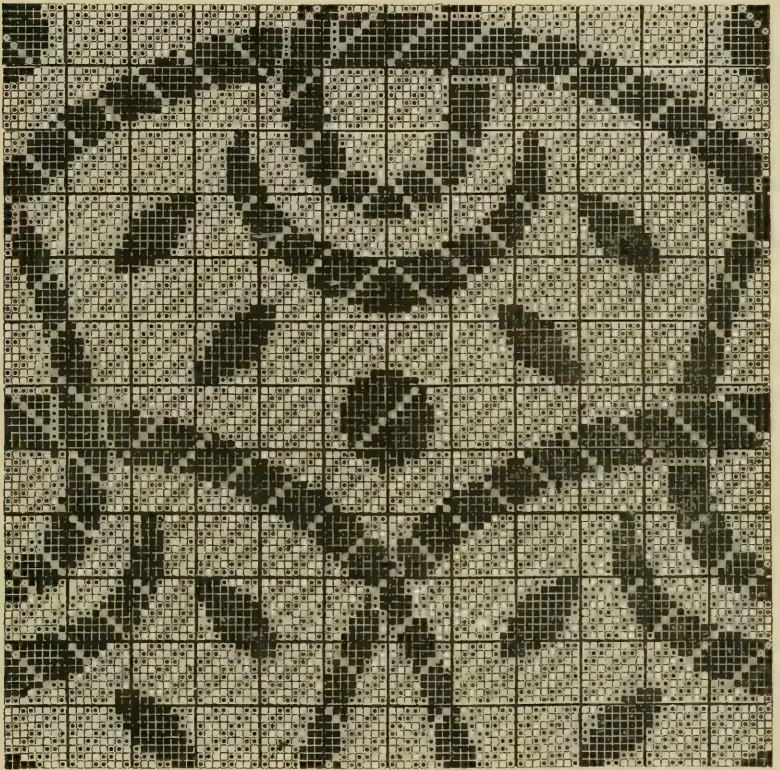


FIG. 261 (*Lift* □'s *and Marks in Grey*).
MOSAIC STYLE: WEFT DIAMOND GROUND WEAVE.

in warp-face sateen, with the interior sections in a weft diamond make ; and, second, the types A are woven in twilled lines. As constructed, this scheme of pattern is applicable to cotton, silk, or union cloths, giving the more satisfactory woven results in close setting and fine counts of yarn.



Lift ▣'s and ⊠'s

FIG. 262.—MOSAIC TYPE IN CURVED LINES.

236. *Curvilinear Forms Spotted.*—Mosaic designs, in which the curved lines interlace, are a development of the principles of woven ornament described in reference to Fig. 261. The several groups of detail are now arranged to intercross with each other ; and the resultant styles may be spotted in warp, weft, or both warp and weft. The elemental lines in Fig.

262 are produced in weft twills, with the spotting in compact floats of weft, and with the $\frac{2}{2}$ twill in the ground, making the style adapted to worsted warp and silk weft manufactures; or, for such weaving particulars as 2/100's worsted warp and 30's spun silk weft, in a 20's reed 4's and 80 picks per inch.

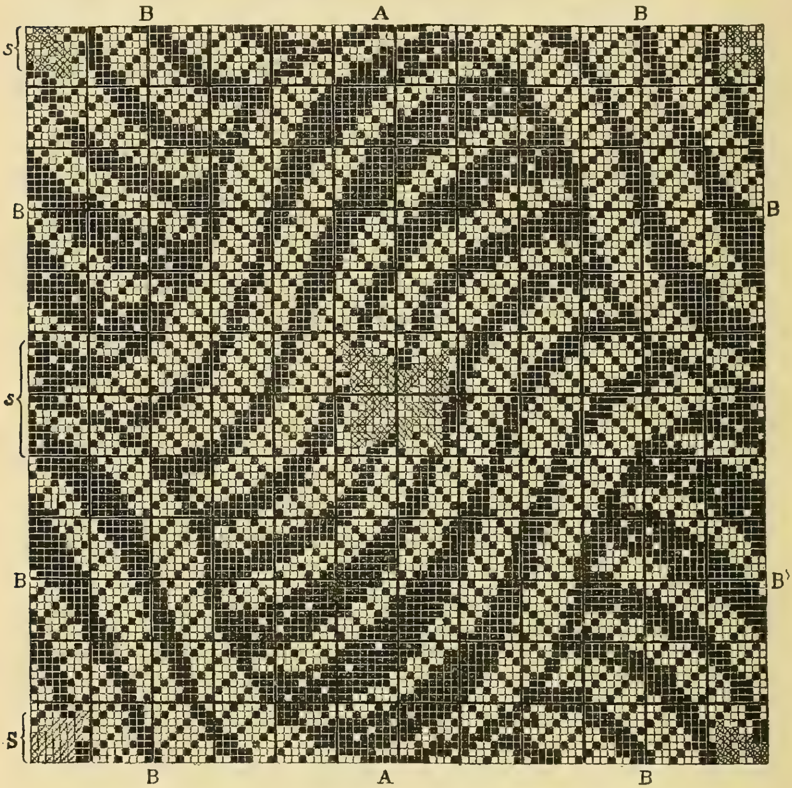


FIG. 263.—WAVED PATTERN IN TWILL AND WEFT EFFECTS.

Changing the ground make to plain, the methods of production to be followed are: (1) that of using cotton warp crossed with artificial silk, and (2) that of using silk warp and silk weft. The distinguishing features of this example are the larger intersecting arc forms, the smaller looped figuring and the crescent details, with the effective grouping of the

spottings. Weft-twilled weaves are applied to all the decorative sections of the design, and in a manner which conforms with the outlines of the curves as well as with their dimensions.

237. *Curved Forms planned on Geometric Principles.*—The motives or types employed in curvilinear patterns may be grouped in geometric relation, or they may be transposed or otherwise arranged. Selecting, for example, an elliptical form, a method of looming preparation is shown in Fig. 263, where the curved details, woven in warp twill and flushed weft, move to the right in sections A, and to the left in sections B. The design is, with or without the extra leaf spotting—in ⊠'s—suggestive of the kind of pattern-work obtainable in waved types, and in contrast with the species of effect of a rectilinear formation. Such curved features should, in the texture, be as correctly delineated as if obtained by the process of cloth printing. That this is feasible arises, first, from the comparatively small scale on which the pattern is produced in the woven fabric ; second, from the drafting of the motives clearly on the point paper ; and, third, from the plan of the weave units and the order of their adjustment.

This design, and also that illustrated in Fig. 261, are to be considered as illustrative of curvilinear pattern structures, repeatable on a limited number of threads and picks. The practice of fine setting in the reeding and in the wefting is essential in producing accuracy of textural origination in this class of ornament, and also in the assortment of other decorative features constructed on a circular basis.

238. "*All-over*" *Design Schemes.*—The term "all-over" is applied to designs in which the effects are so distributed on the surface of the fabric as to give styles of pattern in which the lines of the figuring are blended on a definite but apparently on a nondescript principle. In one important group of such designs, that acquired by drafting weave compounds—Fig. 264—the pattern forms are indefinable ; but, in a second group, that obtained by combining straight or curved lines, or both—Fig. 265—a decided variety of style results, yet one

in which the effects run in an "all-over" formation on the face of the texture. Considering the first group, it is distinctive of designs composed of two or more weave elements. Having selected these, they are grouped in sections, and then

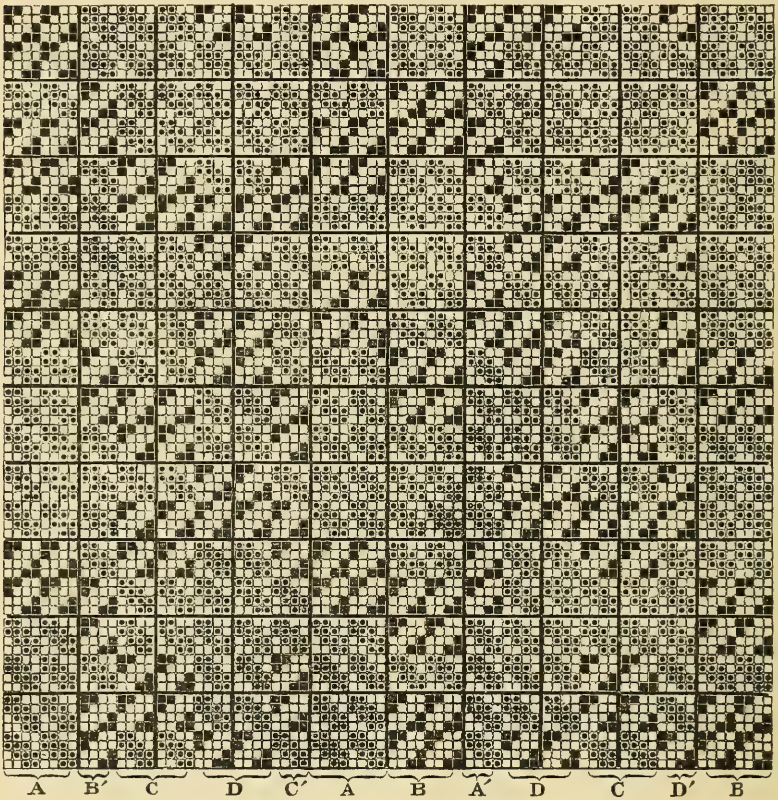


FIG. 264.—"ALL-OVER" DRAFTED DESIGN.

the several sections are re-arranged by the order of healding the warp. Fig. 264, is, for instance, a compound "all-over" drafted style acquired in two weave plans. Its integral parts are A, B′, C, and D. Their sequence by drafting, becomes A, B′, C, D, C′, A, B, A′, D, C, D′, B, yielding the form of weave decoration illustrated. Further, it will be noted

that sections A, B, C and D are composed of eight, and sections A′, B′, C′, and D′ of four threads. Usually several multiples of threads are combined, as, for example, in 3-shaft weaves, three, six, nine, etc., and in 4-shaft weaves, four, eight, twelve, etc., that is in multiples corresponding with the number of

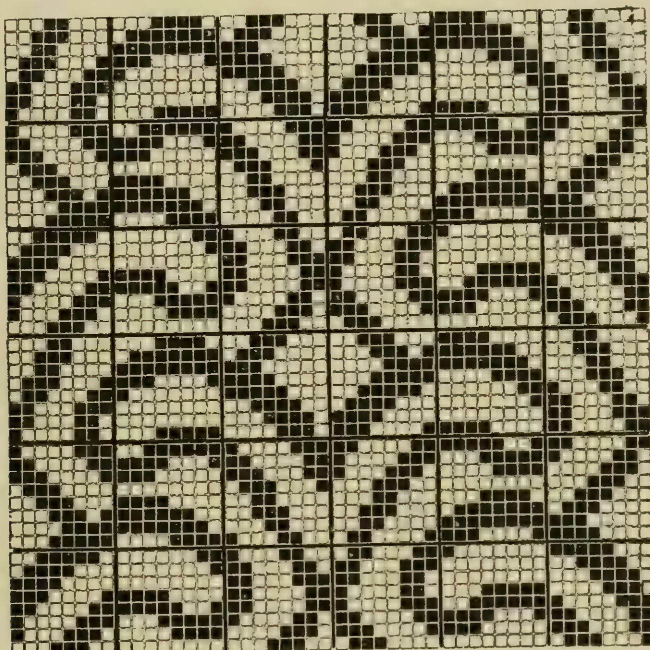


FIG. 265.—WAVED PATTERN ON DRAFTABLE BASE.

threads of which the weaves combined consist. This practice results in the interchanging of the multiples forming each section, which contributes to the varied assortment and composition of the pattern. Uniformity, in the plan of weave distribution, is, however, a characteristic of this group of "all-over" styles, on account of the mathematical system of assorting the sectional parts, and also on account of attaining, by the drafting scheme, an identical aggregate number of threads of each weave unit in the complete design. In the example, there are two sections of eight threads and one

section of four threads of the effects, A, B, C, and D. Here 4-shaft weaves have been employed, but plans on 2, 3, 5, 6, etc., shafts are also used, only the sectional effects would, as explained, in compounds of these weaves, consist of two or four, three or six, five or ten, six or twelve, or other numbers of threads consistent with the multiple of ends and picks on which the weaves are respectively constructed.

239. *Waved "All-Over" Designs.*—This basis of design is originated in the same way as ordinary decorative types, that is in the first instance, sketched on plain paper, and, when a correct repeat unit has been determined, transferred on to the ruled paper for looming. Fig. 265 is such an "all-over" pattern, effective in composition, seeing that it may be woven in a shaft-mounting. The intersections in the design are representative of a definite weave unit, which implies that the design is intended to be applicable to different builds of fabric, according to the weaves used in its development. Four methods of working out the example are as follows—

I.—In two single-plain weaves, when the order of colouring should be 1-and-1 in both warp and weft.

II.—In double-plain makes, and in the same method of warping and wefting, producing the ground and coiled forms in distinct shades.

III.—In a plain ground with weft figuring, weaving with a cotton warp and silk weft.

IV.—In two simple twills, as a warp prunelle twill for the ground, and a weft prunelle twill for the pattern features.

Actual weaving data for these methods of fabric construction are specified below—

METHOD I.—COTTON

Warp.

1 thread of 2/40's cotton, tint 1.
1 „ „ „ „ 2.
36's reed 2's.

Weft.

1 pick of 20's cotton, tint 1.
1 „ „ „ „ 2.
70 picks per inch.

METHOD II.—WORSTED

Warp.

1 thread, 2/60's worsted, shade 1.
1 „ „ „ „ 2.
21's reed 4's.

Weft.

Same as warp, 80 picks per inch.

METHOD III.—UNION

Warp.

2/60's cotton, 40's reed 2's.

Weft.

30's spun or artificial silk.
80 picks per inch.

METHOD IV.—WOOLLEN COSTUME

Warp.

18 skeins woollen, 10's reed 3's.

Weft.

A darker tone of the warp.
28 picks per inch.

240. *Scroll Surface Decoration.*—The scroll and waved form of pattern is strictly a species of "all-over" decorative effect. Thus, Fig. 266 is a running pattern resembling in formation a twisted ribbon. The waved lines, being continuous, should be equally distributed throughout the area of the texture. Unless this rule is observed in originating the sketch, when it is applied to the loom plan and produced in the fabric, bars or stripes of detail are formed, destroying balance of style. For working out the looming design, sateens, plain and repp, or twilled weaves may be combined. Fig. 266 is developed in 5-end makes, with the warp effect in the ground and the weft effect in the ribbon-like lines, so that it is applicable to silk, cotton, and worsted goods, varying the setting with the counts of the yarn employed, and the fineness of the fabric produced.

241. "*All-over*" *Patterns Spotted.*—Well-balanced "all-over" schemes of design are suitable for spotting, in which case they are used for decorating the ground of the fabric.

Either Fig. 265 or 266 may be thus treated, developing the supplementary spotting details, in the former, in extra weft,

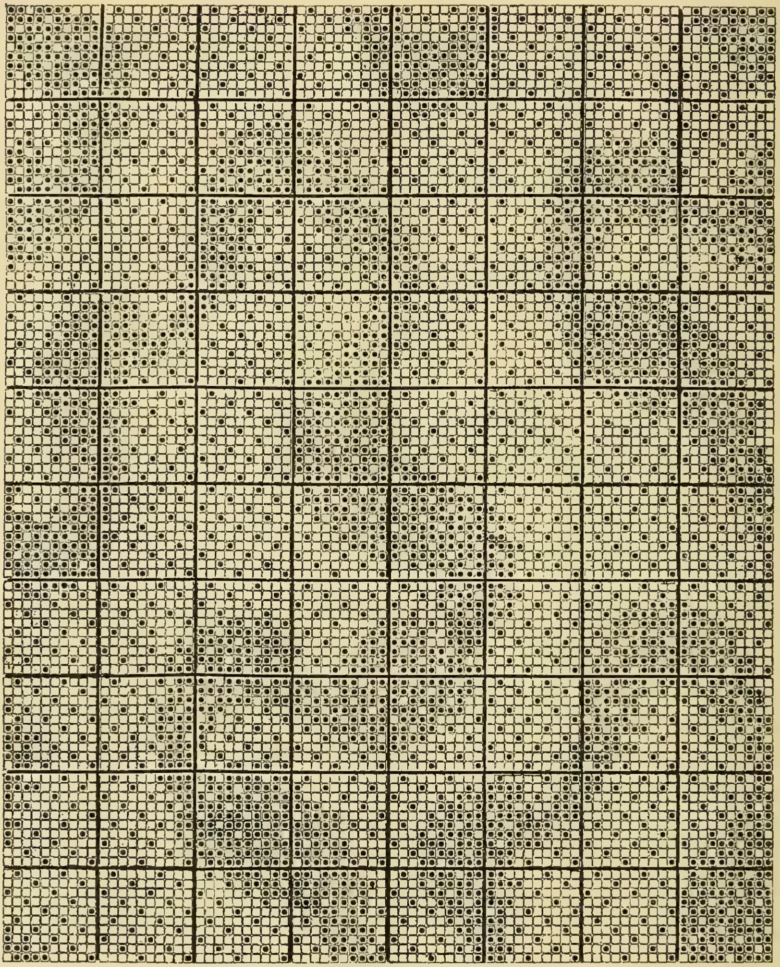


FIG. 266.—RIBBON OR WAVED STYLE.

and in the latter, in extra warp; or the spotted types are weavable in distinct kinds of crossing from those in which the "all-over" pattern features are constructed. Drafted varieties of "all-over" designs (e.g. Fig. 264) are also spotted by each

of these practices. Another method of construction is illustrated in Fig. 267, where, on the irregular mottled ground in weft sateen and plain, two oval forms—the interior of which

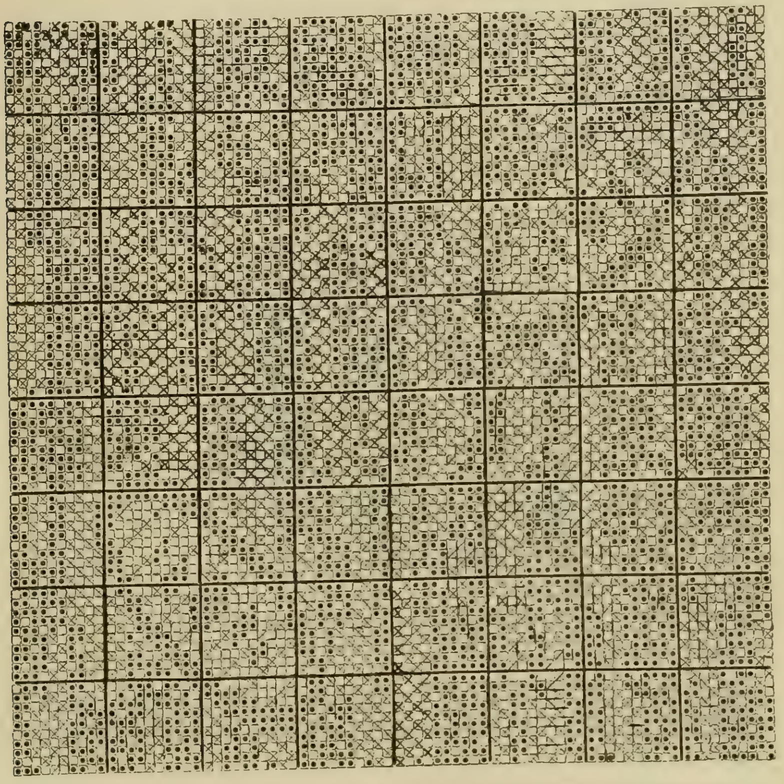


Fig. 267.—Transposed Spotting on "Blotched" Ground.

is spotted in weft details on a warp twill ground—are arranged in transposed positions.

Standard weave units should be used in the origination of these and similar types of pattern, which in decorative minutiae in the ground and in the spotting, are intended to be suitable for either dress or blouse textures woven in different qualities and counts of yarn. The composite structure and the sinuous but balanced figuring, if clearly defined in the fabric,

necessitates the employment of regular crossings in its development. Generally, such figuring is formed in weft-face weaves in contrast with a finer description of weave, as plain and sateen in Fig. 267, warp and weft prunelle twills (I Method, Paragraph 239), Fig. 265, and in two sateens, Fig. 266, but warp and weft cords, plain and twill, and plain and repp plans, may also be selected. The description of weave applied is governed by the character of the scrollwork, and by the class of manufacture desired.

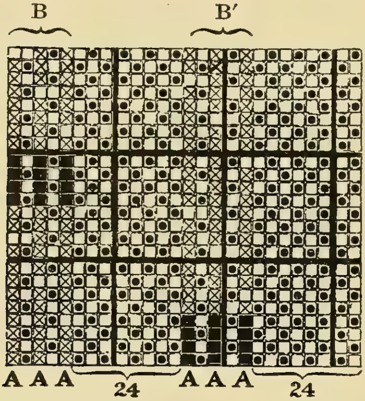


Fig. 268.—Single Thread Extra Warp Spotting.

242. *Extra Warp Effects.**—Spotting or figuring in extra warp or weft, that is in threads or picks, in addition to the yarns employed in making the fabric proper, render the manufactured cloth two or multi-ply in such sections of the style as the special series of yarns occur.

Referring to the extra warp principle as illustrated in Fig. 268, it will be observed that, in parts B and B′, the supplementary sets of threads A, would spot the surface of the texture where marked in ■'s. The ground of the cloth is plain woven. Any structure of weave or plan of decorative design is, however, usable in the production of the piece. The details

* See Chapters XV and XVI in *Colour in Woven Design*, and also Chapter IX in *Union Textile Fabrication.*

obtained in the extra threads are an additional element, but should be in keeping with the design due to the ordinary warp and weft of the cloth, and yet, in a structural sense, they require to be treated as a distinctive feature. It follows that the use of such yarns is in producing—on the face of a common or special type of manufacture—effects in a different tint or different quality of thread from the colour of the warp and weft yarns utilized in building a given grade of fabric. Thus, in Fig. 268, the cloth is plain throughout, but decorated by the threads A, so that by warping and wefting as below, a striped cotton blouse cloth would be made—

Warp.

2/30's cotton, bright colour . .	1	1	1	–	–	–	–	–	–	–
,, ,, white ,, . .	1	1	–	2	1	2	2	1	2	
,, ,, toned ,, . .	–	–	2	1	2	4	2	1	2	

30's reed 2's.

Weft.

2/30's cotton, white, 60 picks per inch.

Obviously, the scheme of grouping the coloured threads in the warp must fit in with the arrangement of the design, while the ground sections are lined in the toned colour on the white ground. By employing cotton for the plain fabric, and worsted yarns for the spotting, the goods are adapted for piece-dyeing, tinting the threads made of the wool fibre, and leaving those made of the vegetable fibre in the natural or undyed state.

243. *Grouping of Spotting Threads.*—The spotting threads may be grouped singly or in series, or in accordance with the origination of any special motive or effect in the cloth. Systems of single-thread spotting with plain, striped, or checked grounds, are exemplified in Table XIII, shown on page 418.

The plans for the ground, which may be of a plain, twill, mock leno, or fancy weave structure, should be constructed to allow the spotting yarns to float over three or more ground picks in succession. In the first order of colouring, four ends

TABLE XIII

Methods of Colouring Single-Thread Warp Spotted Effects

Warp.		Weft.
I	A 30 B 45	
Ground Shade or White .	4 4 8 8	
Fancy Shade (1) or Tone 3, Plate IV, C.W.D.* .	1 1 – –	White or Ground
Fancy Shade (2) or Tone 9, Plate IV, C.W.D. . .	– – 1 1	Shade.
II		
Ground Shade or White .	8 8 8	
Fancy Shade (1) or Tint 4, Plate IV, C.W.D . .	1 – –	White or Ground
Fancy Shade (2) or Tint 10, Plate IV, C.W.D. . .	– 1 –	Shade.
Fancy Shade (3) or Tint 14, Plate VI, C.W.D. . .	– – 1	
III	A 36 A 27	
Ground Shade (1) or White .	4 4 – –	
” ” (2) or Tint 14 Plate VI, C.W D . .	– – 4 4	White or Tint 14 and checked like Warp in ground.
Fancy Shade (1) or Tint 4, Plate VI, C.W.D. . .	1 – – –	
Fancy Shade (2) or Tint 11, Plate IV, C.W.D. . .	– 1 –	
IV		
Ground Shade (1) or White .	6 6 – 6 6 – 6 6 –	White Tint 11,
” ” (2) or Tint 11, Plate VI, C.W.D. . .	– 6 6 – 6 6 – 6 6	White, Tint 11, and
Fancy Shade (1) or Tint 5, Plate VI, C.W.D. . .	1 – – – 1 – – – –	6 picks, White.
Fancy Shade (2) or Tint 11, Plate IV, C.W.D. . .	– 1 – – – – 1 – –	12 ” Tint 11.
Fancy Shade (3) or Tint 14, Plate IV, C.W.D . .	– – – 1 – – – 1 –	6 ” White.
V		
Ground Shade (1) or Tint 4, Plate VI, C.W.D. . .	5 5 – – – –	White, Tints 4, 10, 14, and
Ground Shade (2) or Tint 10, Plate VI, C.W.D. . .	– – 5 5 – –	
Ground Shade (3) or Tint 14, Plate VI, C.W.D. . .	– – – – 5 5	10 picks, Tint 4
Fancy Colour, Tint 10, Plate IV, C.W.D . .	1 – 1 – 1 –	10 ” ” 10
		10 ” ” 14
VI	A	Repeat A
Ground Shade (1) or White .	4 4 4 4 4 – – – – –	– – – – –
” ” (2) Tint 6 Plate VI, C.W.D . .	– – – – – 4 4 4 4 4	– – – – –
Ground Shade (3) Tint 18, Plate IV, C.W.D. . .	– – – – – – – – – –	4 4 4 4 4
Fancy Shade (1) Tint 4, Plate IV, C.W.D. . .	1 – 1 – – 1 – 1 – –	1 – 1 – –
Fancy Shade (2) Tint 10, Plate VI, C.W.D. . .	– 1 – 1 – – 1 – 1 –	– 1 – 1 –

VI.—*Wefts.*—White, Tint 6 or 10 and checked in the ground colours to match the order of warping.

* Colour in Woven Design.

of ground weave and one end of spotting are combined for 30 threads, followed by eight ends of ground and one end of spotting for 45 threads. In other words, the order of grouping the two types of yarn requires, in the weave scheme, to tally with the system of warping. Taking, in illustration,

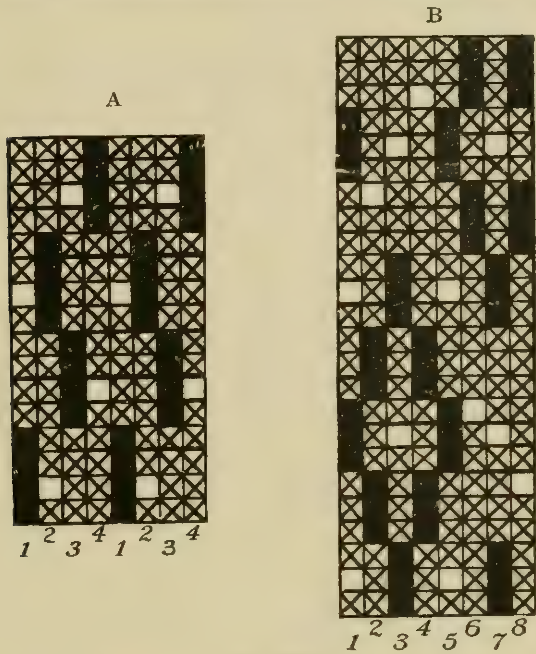


Fig. 269.

the spotting threads to be arranged as in A and B, Fig. 269, the looming practices for Colour Schemes I and II would be—

Scheme I

4 threads of ground weave, e.g. plain or twill, and the first thread of plan A, Fig. 269.
4 „ „ „ „ plain or twill, and the second thread of plan A, Fig. 269.
4 „ „ „ „ plain or twill, and the third thread of plan A, Fig. 269, etc.

Scheme II

8 threads of ground weave, e.g. plain, mat or fancy weave, and the first thread of B, Fig. 269.
8 „ „ „ „ plain, mat or fancy weave and the second thread of B, Fig. 269, etc.

From these sectional plans—A and B, Fig. 269—it will be seen that the spotting ends may be assorted to run in a broken twill, sateen, or other simple arrangement, or they may be made to give a small "motive" effect should eight or more threads be selected for this purpose. Further, it will be understood that, for the purpose of accentuating the spotting, they may first be grouped singly, second in pairs, third developed in thicker yarns than the threads in the ground warp, and fourth, they may be inserted in irregular and frequent order into the ground of the cloth.

On examining the Colour Schemes in Table XIII, the following features of the yarn groupings specified will be apparent—

In Scheme I the spottings would form a striped effect, the threads being grouped four-and-one in section A, and eight-and-one in section B. In Scheme II, three spotting yarns, running in regular sequence, are used, but their order might be varied on such principles as—

(*a*)	3	spotting	threads	of Fancy	Colour	(1)
	1	,,	thread	,,	,,	(2)
	1	,,	,,	,,	,,	(3)
(*b*)	1	spotting	thread	of Fancy	Colour	(1)
	2	,,	threads	,,	,,	(2)
	1	,,	thread	,,	,,	(1)
	2	,,	threads	,,	,,	(3)
(*c*)	2	spotting	threads	of Fancy	Colour	(1)
	2	,,	,,	,,	,,	(2)
	2	,,	,,	,,	,,	(3)

having necessarily the requisite number of ground threads between such spotting ends.

In Scheme III, the ground shade (1) is spotted with tint 4, and shade (2) with tint 11. The spotting colours harmonize with the ground shades. In this system of colouring checked styles are obtained by matching the order of the ground shades in the weft; in Scheme IV the ground sections are

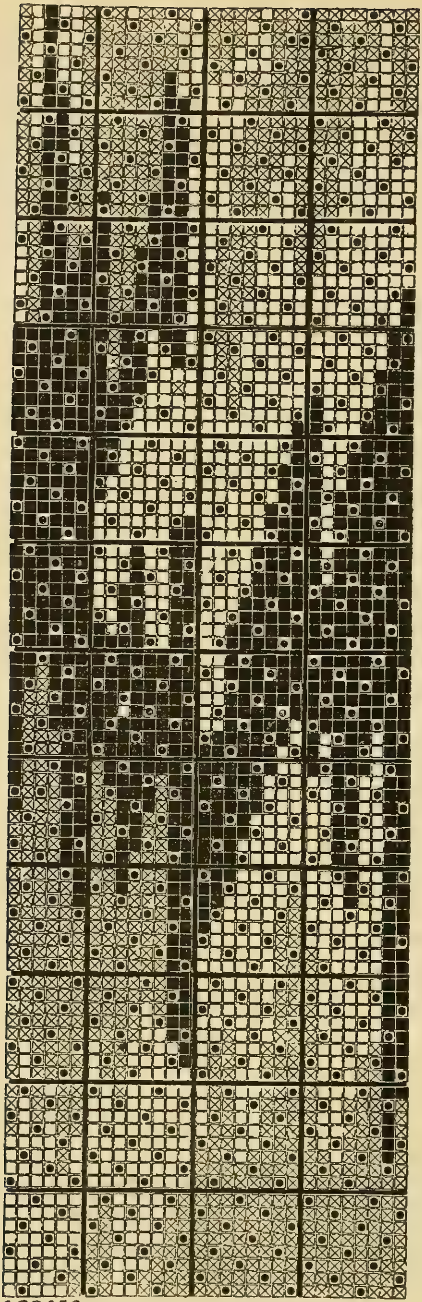
warped 12-and-12 and spotted in three tints: in Scheme V, three ground shades are combined in 10-and-10 order, and spotted with one fancy colour: and in Scheme VI, three ground shades, warped 20-and-20, are spotted with tints 4 and 10, the spotting colours toning with the shades in the ground.

It will be understood that the number of threads in each scheme are simply suggestive of those feasible, and that they would be variable in practice.

244. *Figuring in Two or Three Extra Yarns.*—For figuring in extra warp yarns, the supplementary threads may be run in regular sequence with the ground warp threads. This makes it possible to produce pattern features in all parts of the fabric, and in a manner distinct from spotting its surface at intervals, as when the extra yarns are sectionally inserted into the cloth. By taking a figured effect of this character, and using two extra yarns, this design practice will be understood from the example in Figs. 270 and 270A. Here is seen the actual formation of the mottled or blotched type of effect which would be woven in the cloth if three shades of warp yarn were used. Each thread in the plan corresponds to three threads in the looming, so that the □'s are to be considered as representing one effect, the ⊠'s a second, and the ■'s a third effect. Assuming the order of the warp to be—

1	thread	of	2/60's	cotton		white
1	,,	,,	60's	2-fold	silk	tinted grey
1	,,	,,	,,	,,	,,	toned grey

and the weft white, with 180 threads and 80 picks per inch in the loom, the sections in □'s would be in white, those in ⊠'s in tinted grey, and those in ■'s in toned grey. As in Fig. 268, the spotting ends float on the underside of the fabric when not used on the right side for decorative purposes, so in this structure each shade of yarn, when not appearing in the figure, is intersecting in sateen order on the reverse



1 2 3 4 5 6

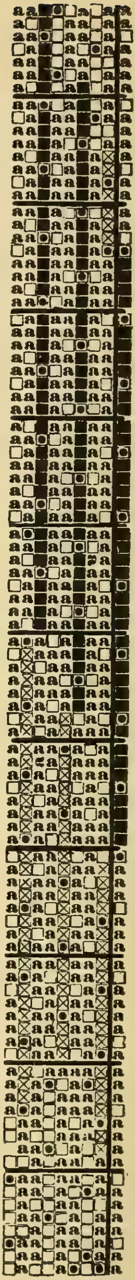


Fig. 270. (*Section only.*) Fig. 270a.

Extra Warp "Blotched" Type.

side of the cloth. The sectional plan (Fig. 270A) makes this clear. It is composed of threads three, four, and five of Fig. 270, in the exact relation in which they would occur in the weaving process. Each of these three threads corresponds to three separate warp yarn units in the textures, giving nine threads in the cloth arranged thus—

Thread 3, Fig. 270—

Intersections in ☐'s	=	white or thread	.	1 in Fig. 270A.
,, ,, ⊠'s	=	tinted grey or thread		2 ,, ,,
,, ,, ■'s	=	toned grey or thread		3 ,, ,,

Thread 4, Fig. 270—

Intersections in ☐'s	=	white or thread	.	4 ,, ,,
,, ,, ⊠'s	=	tinted grey or thread		5 ,, ,,
,, ,, ■'s	=	toned grey or thread		6 ,, ,,

Thread 5, Fig. 270—

Intersections in ☐'s	=	white or thread	.	7 ,, ,,
,, ,, ⊠'s	=	tinted grey or thread		8 ,, ,,
,, ,, ■'s	=	toned grey or thread		9 ,, ,,

In addition to this example illustrating the principle of extra warp design construction, it is illustrative of an economic system of manufacture in which only one third of the number of picks as threads is needed. The weft neither shows on the face nor on the back of the fabric, but lies between the three series of warp yarns. Hence, each of the threads—white, tinted, and toned grey—in Fig. 270A, where not interlacing in warp sateen on the right side of the cloth, interlaces in warp sateen (as shown in the details $\boxed{a}$) on the underside. Here 5-shaft weaves are combined, but 7-shaft and 8-shaft sateens and diamond and twilled makes, may also be applied.

245. *Extra Weft Spotting.*—The method of inserting weft spots, or of using extra yarns in the weft, for special colour effects, is first shown in Fig. 271, the design for the *piqué* texture in Fig. 271A. Apart from the spottings in ■'s, it is an effective build of fabric, with the ground in $\frac{3}{3}$ warp cord, and the pattern details in flushed weft and in warp

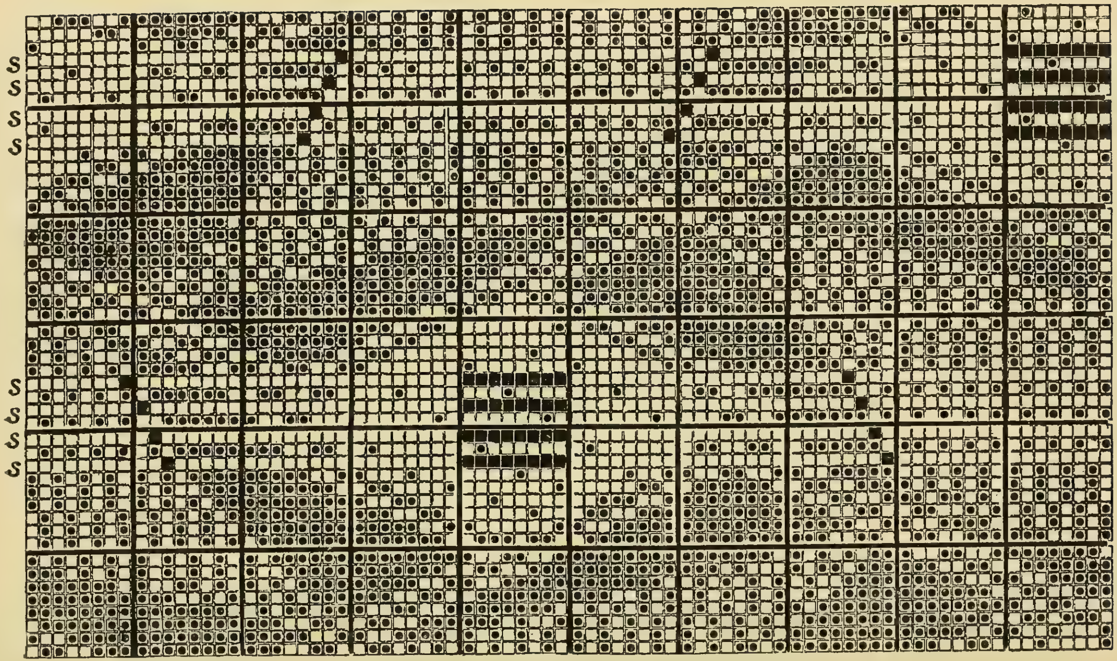


FIG. 271.—EXTRA WEFT YARN PATTERN.

sateen, the specimen having been produced in 2/60's mercerized cotton warp, 32's reed 4's, and wefted—

	13	picks of 2/30's	mercerized cotton, ground shade.
For 7	1	,, ,, ,,	fancy cotton.
	1	,, ,, ,,	mercerized cotton or silk.
	17	,, ,, ,,	,, ,, ground shade.
For 7	1	,, ,, ,,	fancy cotton.
	1	,, ,, ,,	mercerized cotton.
	3	,, ,, ,,	,, ,, ground shade.
	60 to 64 picks per inch.		

The extra picks in the design run on the back of the texture —except in the parts in which they decorate the face of the

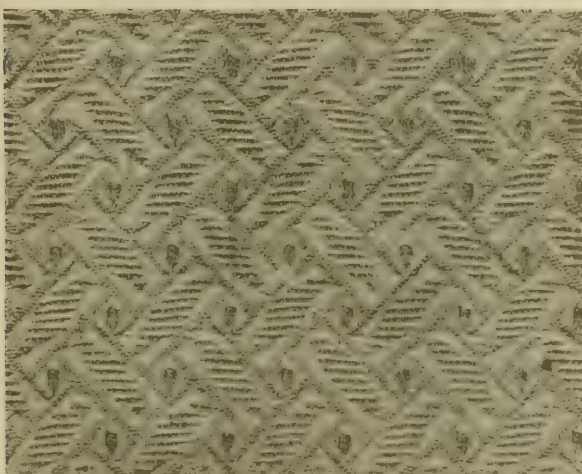


FIG. 271A.

cloth—on the same system as the extra threads A in Fig. 268. This is the rule for the insertion of the spotting picks in this class of patternwork. Consider, for instance, the development of the spotted motives in Figs. 222 and 263. They involve the picks on which they occur, being stamped twice in preparing the designs for the loom, for each of the picks in parts S represents two shots of weft in the weaving of the fabric. Thus, in Fig. 222, the details *a* indicate the positions in which the spotting picks would be tied on the underside

of the fabric ; but such picks also constitute the ordinary weave effect in the ground of the texture : hence, for preparing the cards for, say, the first two picks of the design, the order of stamping would be—

1st Weft line 1	= first ground pick	—lift or cut	■'s	and	□'s.
2nd Weft line 1	= first spotting pick	— ,,	,, grey marks	,,	□'s.
3rd Weft line 2	= second ground pick	— ,,	,, ■'s	,,	□'s.
4th Weft line 2	= second spotting pick	— ,,	,, grey marks	,,	□'s.

The stitching points are not shown in Fig. 263, but the method of stamping for the spotting picks would follow that of Fig. 222, that is, with the addition of the necessary number of ties for securing such picks regularly to the underside of the fabric.

246. *Weft Ground and Extra Yarn Spotting.*—When warp-face weaves are employed in the ground of the texture, parts of the spotting may be produced in the ground weft, and special parts in the extra weft yarn. Prunelle, $\frac{1}{3}$ and sateen twills, warp cords and warp-face corkscrews, etc., are all used in this build of cloth. The examples—Figs. 272 and 273—are suggestive of the employment of a twilled make in the ground. This enables a pattern quality to be obtained in the ordinary weft—marked in ⊡'s—as well as in the extra yarn—marked in ■'s. Each line of weft in the sections bracketed A and B, in Fig. 272, corresponds to two and three picks of weft as explained relative to Figs. 222 and 263. While the use of the ground weft here, proves economical in weaving, it somewhat restricts the diversity of colouring, particularly as regards the degree of contrast admissible between the colour of the extra weft yarn and that of the warp yarn. The reason for this is, warp-face twills do not provide such suitable positions for the insertion of the ties as weaves in which the warp and weft are equally intersected. It should, however, be understood that a warp-face plan, in the ground sections, helps to emphasize the figuring due to the shuttling yarn applied in the construction of the fabric.

247. *Warp and Weft Orders of Colouring applied to Decorative Pattern Construction.*—Each weave unit not only produces a specific build and variety of fabric, but, in fixed orders of warping and wefting, yields definite and standard types of pattern. It follows that the "colour effects," characteristic of the different plans of intertexture, are combinable in the

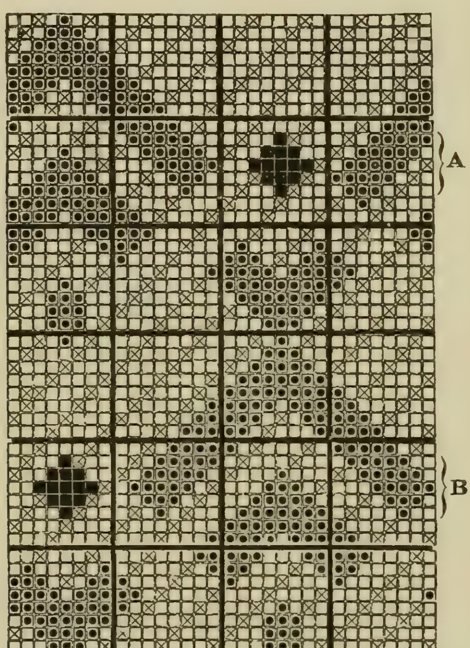


FIG. 272.—MOSAIC TYPE WITH EXTRA YARN FEATURES.

formation of geometric, spotted, and mosaic styles of design, in which the integral features are formed in distinctive weave units, and developed in certain arrangements of warp and weft threads, such as 1 and 1; 2 and 2; 3 and 2; 2, 1, 1 and 1; 2, 2 and 2; 3 and 3, etc. The practice involves, first, the working of the design sketch on point paper in colour, using three or four tints; second, the selection of weave elements

adapted to the effective development of the several sections of the design; and third, the application to the latter of schemes of warping and wefting suitable for delineating the several outlines and features of the style.

Factors I and II have been treated of, and are common to

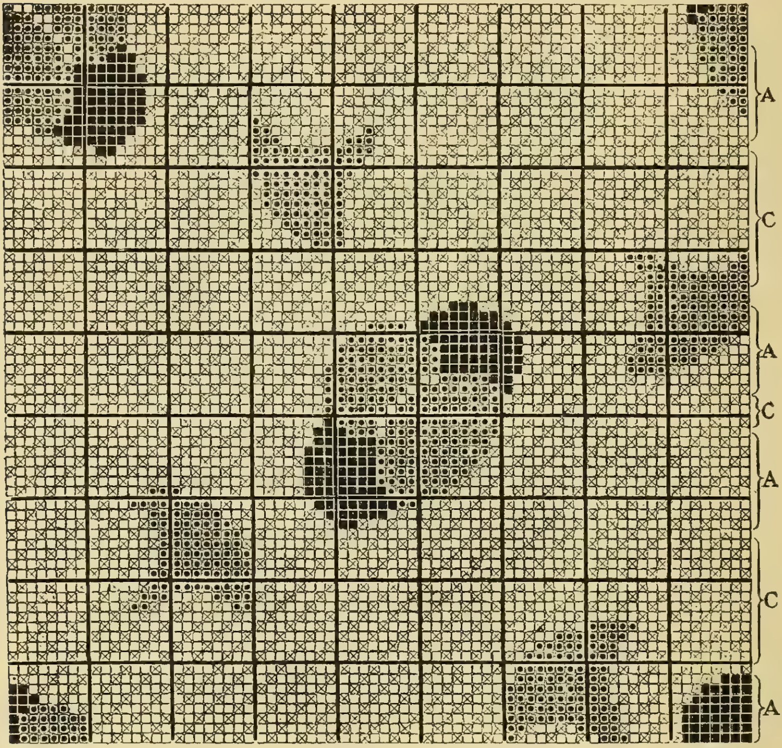


Fig. 273.
Six-end Sateen Spotted Base, with Extra Yarn Spottings.

all descriptions of decorative design. The third factor comprises both the theory and principles of textile colouring as understood in applying orders of warping and wefting, in two, three, and more colours, to standard weave structures. Interlacing, for example, two shades of warp and weft yarns, 1-and-1 in a plain woven texture, gives hair-line stripe effects;

in the cassimere, two varieties of step twill; in the double-plain make, one shade of cloth over another; in warp cord, transverse lines in the two colours; and in weft cord, lines in the two shades warp-ways of the cloth. Changing the order to 2-and-2 produces in the plain crossing the type of effect at *b* in Fig. 65 B; in the cassimere a small check, and in the 2-and-2 mat a star check. Different systems of yarn grouping such as those specified in Table XIII, and different weave elements, modify the pattern types obtained. Textural details, due to colour and weave, of this character, are usable in developing spotted and figured designs, as may be explained by reference to Figs. 226, 264, and 273, when warped and wefted thus—

FIG. 226.—*Warp and Weft.*

1 thread of shade (1)
1 „ „ „ (2)

FIG. 264.—*Warp and Weft.*

2 threads of shade (1)
2 „ „ „ (2)

changing (Fig. 264) the sections in ⊡'s to plain and those in ■'s to $\frac{2}{2}$ twill.

FIG. 273.—*Warp and Weft.*

1 thread of shade (1)
1 „ „ „ (2)

changing—Fig. 273—the prunelle to plain weave, and producing the spotted sections in ⊡'s in double plain, and those in ■'s in the inverted double-plain crossing.

As a result of the order of colouring for Fig. 226, the design would be developed in hair-line effects, with the sections in grey in the lines lengthways of the texture, and the sections in ■'s across the texture. The "all-over" drafted pattern, Fig. 264, when modified as indicated above, would consist in the ground of the effects seen at A, Fig. 67, and, in the $\frac{2}{2}$ twill sections, of small checkings; while the ground of Fig. 273 would be in fine lines, and the spottings printed in ⊡'s in shade (1), and those printed in ■'s in shade (2). Weave

and colour assortment are, in these examples, observed to retain the pattern form in each instance, but to alter completely the textural style and tone.

Spotted and "over-all" schemes of design are specially adapted for this practice in looming, arranging the spotted motives on a sateen or geometric basis, and constructing the "all-over" patterns on the drafted principle. The weave plans and orders of colouring commonly employed in making such styles, with the types of effect they severally produce, are described in Table XIV.

TABLE XIV

PATTERN TYPES DERIVED FROM FUNDAMENTAL WEAVES IN SIMPLE ORDERS OF WARPING AND WEFTING*

Order of Warping and Wefting.	*Weave Unit.*	*Textural Effect.*
1 thread of Shade (1) 1 ,, ,, ,, (2)	Plain	Hair-line stripes in the direction of the warp or in the direction of the weft.
Ditto, in the Warp crossed with one shade of Weft yarn	Warp-cord	Transverse lines in the two yarn shades.
Ditto, in the Weft, using one shade of Warp yarn	Weft-cord	Longitudinal lines in the two yarn shades.
1 thread of Shade (1) 1 ,, ,, ,, (2)	$\frac{2}{2}$ Twill	Small step twill in the shades combined.
ditto	Warp Swansdown	Similar to the plain but in finer set cloths.
ditto	Weft	Ditto, but in transverse lines.
ditto	Double-plain	Two textures, one over the other, in Shades (1) and (2) respectively.
2 threads of Shade (1) 1 ,, ,, ,, (2)	Plain	Small lines in Shade (2) at right angles to each other on a ground woven in Shade (1).
2 threads of Shade (1) 1 ,, ,, ,, (2)	Prunelle	Hair-line stripe with the lines in two threads in Shade (1), and in one thread of Shade (2).
2 ,, ,, ,, (1) 2 ,, ,, ,, (2)	Plain	As in Fig. 67A.
ditto	$\frac{2}{2}$ Twill	Small checking.
ditto	$\frac{2}{2}$ Mat	Star Check.
3 threads of Shade (1) 1 ,, ,, ,, (2)	Warp Swansdown	Hair-line stripe with the lines in three threads in Shade (1) and in one thread in Shade (2).
ditto	Weft ,,	Ditto, but across the piece.

* See Chapter VIII, *Colour in Woven Design.*

TABLE XIV—(*continued*)

Order of Warping and Wefting.	*Weave Unit.*	*Textural Effect.*
3 threads of Shade (1) 2 „ „ „ (2)	$_2{}^3$ Twill	Irregular check.
ditto	$_2{}^3$ Mat	Lines in the warp or in the weft.
3 threads of Shade (1) 3 „ „ „ (2)	Plain	Broken check.
ditto	$_2{}^2$ Twil	Well-defined twilled check.
ditto	$_3{}^2$ Mat	Broken check.
1 thread of Shade (1) 1 „ „ „ (2) 1 „ „ „ (3)	Plain	Three groups of lines at right angles to each other.
ditto	$_3{}^3$ Twill	Ditto, but lines less defined.
2 threads of Shade (1) 1 „ „ „ (2) 1 „ „ „ (3)	Warp Swansdown	Hair-line stripe with lines in two threads in Shade (1) and in single threads in Shades (1) and (2).
2 „ „ „ (1) 1 „ „ „ (2) 1 „ „ „ (3)	Weft	Ditto, but across the piece.
2 „ „ „ (1) 2 „ „ „ (2) 2 „ „ „ (3)	$_2{}^2$ Mat	Effect A, Fig. 68B.
ditto	$_3{}^3$ Twill	Similar effect, but more broken in structure.
2 threads of Shade (1) 1 „ „ „ (2) 1 „ „ „ (3) 1 „ „ „ (4)	5-end Warp Sateen or Twill	Hair-line stripe with lines in two threads in Shade (1), and in single threads of Shades (2), (3), and (4).
ditto	5-end Weft Sateen or Twill	Ditto, but across the piece.
1 thread of Shade (1) 1 „ „ „ (2) 1 „ „ „ (3) 1 „ „ „ (4) 1 „ „ „ (5)	5-end Warp Sateen or Twill	Hair-line stripe in five shades.
ditto	5-end Weft Sateen or Twill	Ditto, but lines across the piece.

248. *Compound Weave Spotting and Figuring.*—The principles and technicalities of decorative design in compound weaves are specially analysed in Chapter IX. Here, however, some explanation of the use of these weaves in originating spotted patterns, needs to be given. The ordinary makes employed are—

Double-plain ;
Double-prunelle ;
Double-cassimere, and
Double-sateen.

Three-ply weaves are also employed and compound makes with different weave units on the two surfaces, and also treble makes, in which the face, centre, and backing weaves may differ, or be the same in structure, such as—

Double Structures.*

(*a*) Plain-woven on one side, and mat or twill-woven on the other side, with the two textures interchangeable.
(*b*) Cassimere on one side, and mat or cord on the other side, with the two textures interchangeable.
(*c*) Sateen on one side, and twill-woven on the other.

Three-ply Structures.*

(*a*) Plain weave face, centre and back, with each texture interchangeable.
(*b*) Prunelle twill face, centre and back, with each texture interchangeable.
(*c*) Cassimere twill face, centre and back, with each texture interchangeable.
(*d*) $\frac{2}{2}$ twill face, plain centre and $\frac{2}{2}$ mat back, with each texture interchangeable.
(*e*) $\frac{3}{3}$ twill face, prunelle twill centre, and $\frac{3}{3}$ mat back, with each texture interchangeable.

Double-weave structures produce one cloth unit composed of surface and underside textures, and in three-ply weaves they produce one cloth composed of three textures, one over the other, with, as stated, two or three textures interchangeable in position, that is, they may form either the face or back of the fabric in the double-makes, or the face, centre or back successively in the treble makes.

The subject is illustrated in plans A, B, and C, Fig. 274, three double-plain effects forming striped, checked, and spotted pattern types. If coloured, in the warp and in the weft, one thread of light fawn and one thread of tinted green, the grey and black details in the plans would be in fawn in the cloth, and the white and dotted details in green. Otherwise dissected, section 1 in A, Fig. 274, would give a plain-woven fawn texture covering a plain-woven green texture,

* See Chapter XIII, *Woollen and Worsted.*

and section 2 a green covering a fawn texture. This possible interchange of the two textures from face to back and *vice versâ,* renders it practicable to produce any description of spotted or decorative style by applying weave 1 to the coloured sections of the design on the point paper, and running weave 2 on to the ground. Adapting this practice to Fig. 238, the pattern would be sketched in colour on the ruled paper to the required scale, then weave 1, Fig. 274, would be dotted on the pattern thus prepared, and weave 2 applied to the ground;

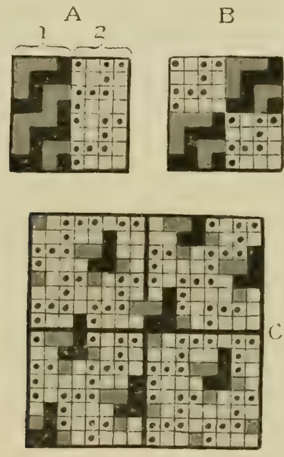


FIG. 274.—DOUBLE PLAIN STRUCTURES.

so that with the order of colour specified for Fig. 274, the design features in Fig. 238 would be developed in fawn colour on a green surface. To produce the same pattern in twill or in twill and mat, it would only be necessary to select double-weaves of the description given above. Should the decorative elements be desired in two colours, and in two types of texture, with the ground in a third texture, then the "rosette" forms, Fig. 238, would in transferring the sketch on to point paper, be drawn in one colour, and the line characteristics in a second colour, and three-ply weave structures employed, such as plans made on the principle of

(*d*) or (*e*). This would, however, require to be made in three forms, namely, for plan (*d*)—

(1)	1 thread	and	1 pick	face	=	$_{2}^{2}$ twill.
	1 ,,	,,	1 ,,	centre	=	plain.
	1 ,,	,,	1 ,,	back	=	$_{2}^{2}$ mat.
(2)	1 ,,	,,	1 ,,	face	=	plain.
	1 ,,	,,	1 ,,	centre	=	$_{2}^{2}$ mat.
	1 ,,	,,	1 ,,	back	=	$_{2}^{2}$ twill.
(3)	1 ,,	,,	1 ,,	face	=	$_{2}^{2}$ mat.
	1 ,,	,,	1 ,,	centre	=	$_{2}^{2}$ twill.
	1 ,,	,,	1 ,,	back	=	plain.

If these three plans should be used, thus—

No. (1) in the ground, No. (2) in the floral forms, and No. (3) in the line effects ; they would result in the ground being twill woven on the face and mat woven on the back, the floral forms in plain on the face and mat on the back, and the line features in mat on the face and plain on the back.

249. "*All-over*" *Patterns Developed in Double Weaves.*— "All-over" patterns of the class illustrated in Fig. 264, are producible in double weaves. Providing that, in this design, the number of threads in sections A to D should be increased respectively to 6 and 12, and two double-plain makes arranged—

1 thread of ground yarn,
1 ,, ,, spotting or figuring yarn, and
1 ,, ,, ground yarn—

should be applied, the style acquired would be of the type sketched in Fig. 275, which has been warped and wefted thus—

For 48 threads.	1 thread of	worsted	yarn,	dark shade.
	1 ,,	,,	,,	light shade.
	1 ,,	,,	,,	dark shade.
For 48 threads.	1 ,,	,,	,,	dark shade.
	1 ,,	silk	,,	light shade.
	1 ,,	,,	,,	dark shade.

In the specimen—Fig. 275—the weave units interchange the positions of the two groups of yarn according to their

distribution, or according to the system in which they are combined, which, in this example, consists in applying a double-plain make, which takes the spotting yarn on to the underside of the fabric in the place of the plan marked in ⊡'s, in Fig. 264, and a double-plain make, which brings this yarn on to the surface, in the place of the plan marked in ■'s. That compound makes of this order are also combinable in constructing spotted styles in which the motives are planned

FIG. 275.—ALL-OVER EFFECT IN DOUBLE-PLAIN WEAVES.

on a geometric base, is evident from the illustration in Fig. 276. Here the threads and picks marked in ⊠'s, ⓐ's, and in ■'s interlace plain, the order of the threads being—

1 end of ground ;
1 „ spotting ; and
1 „ ground in both warp and weft.

The ground yarns in the design make a common twilled texture, but the plain weave, or any other suitable plan might also be used. Examining the threads and picks, S, S′, it will be seen that they intersect plain throughout, but only appear on the face in such positions of the design where marked in

the symbols $\boxed{a}$'s and ■'s, that is, in the spotted features. Assorting the yarns in the looming and in the shuttling—

1 thread of toned brown,
1 ,, ,, tinted brown, and
1 ,, ,, toned brown,

would produce a cloth on the surface with the ground in

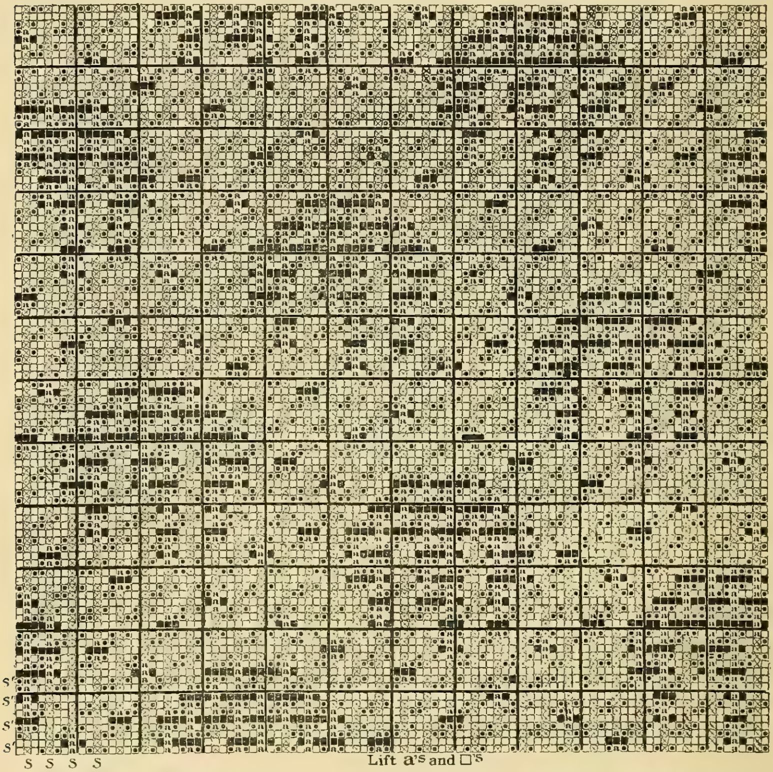


FIG. 276.—REVERSIBLE MAKE OF SPOTTED DESIGN—EIGHT-END SATEEN BASE.

toned brown, and the spottings in tinted brown, and on the underside, with the two colours interchanged in position.

250. *Figured Pattern Origination by the use of Double Weaves and Orders of Warp and Weft Colouring.*—It has been

explained how, by combining several weaves in one simple order of colouring, the ground and the decorative elements in figured designs are produced. With two or three double-weave units, the "colour effects" they give are interchangeable on like principles as in the combination of single-weave colour types. Having, for example, double weaves constructed and coloured on the following lines—Table XV—it is feasible to interchange the effects which they produce on the face and back of the fabric respectively.

TABLE XV

Interchangeable Double-Weave Structures in Figured Pattern Development

A.—Double-plain Weave coloured in both warp and weft in the surface texture—

1 thread of Shade (1).
1 ,, ,, ,, (2).

And coloured in the underneath texture in Shade (1).

B.—Double-prunelle Weave coloured in both warp and weft in the surface texture—

2 threads of Shade (1).
1 thread of Shade (2).

And coloured in the underneath texture—

1 thread of Shade (1).
2 threads of Shade (2).

C.—Double-cassimere Weave coloured in both warp and weft in the surface texture—

1 thread of Shade (1).
1 ,, ,, ,, (2).

And coloured in the underneath texture—

2 threads of Shade (1).
2 ,, ,, ,, (2).

D.—Double-Structures with Plain face and $\frac{2}{2}$ Mat back, coloured in both warp and weft in the surface texture—

1 thread of Shade (1).
1 ,, ,, ,, (2).

And coloured in the underneath texture—

2 threads of Shade (1).
2 ,, ,, ,, (2).

The pattern types obtainable by these compound weave units and colourings comprise—

Plan A.—Face texture, in hair-line stripes.
Under texture, in solid colour.

Plan B.—Face texture, in hair-line stripes, with lines in two threads of Shade (1), and in single threads of Shade (2).
Under texture, in hair-line stripes with lines in two threads in Shade (2), and in single threads of Shade (1).

Plan C.—Face texture, in stepped twill effect.
Under texture, in checked effect.

Plan D.—Plain texture, in hair-line stripes.
Mat texture, in star check effects.

Providing, as explained, two weaves—one the reverse of the other—are employed, e.g. types A and B or C and D, the pattern units in the two weave types are interchangeable in design construction. Outlining in colour, for example, Fig. 239 on point paper, and running weave A on to the ground, and the reverse of A on to the figured sections, would give the ground in hair-line stripes, and the figuring in a plain colour; or changing the weave to C for the figuring, and this weave inverted for the ground, would give the former in a step twill and the latter in small checks.

In selecting weave units for combination in the development of this description of design, their structural character has to be taken into account, and also the character of the effect which they give in a specific order of warping and wefting. If the designs should be full of detail, the smaller weave units and the simpler orders of colouring are the more suitable. On the other hand, should the decorative types employed be framed on a geometric or sateen basis, then the $\frac{1}{2}$, the $\frac{3}{3}$, and the $\frac{4}{4}$ systems of shade arrangement may be utilized. In addition, varieties of figured styles are preparable for the loom in two sateen weaves—warp and weft-face in structure—which are adapted for textural production in hair-line effects in three, four, and five shades.

251. *Spotting in the Backing Threads and Picks of Double Weaves.*—A useful practice in spotting compound-make cloths is that of bringing certain backing yarns on to the face, or on the principle of intertexture illustrated in Fig. 277. In this design the ends A and the picks B interchange from the under to the face side of the fabric in the positions marked in [a]'s, and in ■'s. The ground of such textures is weavable

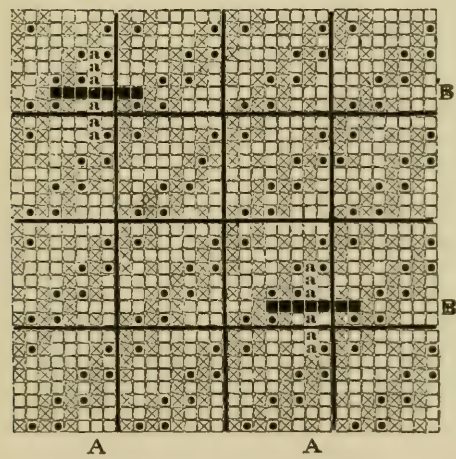


FIG. 277.—DOUBLE-WEAVE SPOTTED WITH BACKING THREADS AND PICKS.

in one shade, or it may be striped or checked with the transposed spotting threads in a bright colour, or in a distinct sort of yarn from that used in the body of the texture, as, for example—

FIG. 277.—WORSTED COSTUME

Warp.

6 threads of 2/64's worsted ground shade.
1 thread of 2/30's bright colour mercerized cotton.
9 threads of 2/64's worsted ground shade.

Weft.

9 picks of 2/64's worsted ground shade.
1 pick of 2/30's bright colour mercerized cotton.
6 picks of 2/64's worsted ground shade.

FIG. 277.—COTTON DRESS FABRIC
(but changing the design to a double-plain make structure).

Warp.

Face yarn—		
Tint (1)	2	2
„ (2)	4	–
Backing and Spotting yarn—		
Tint (1)	3	4
Silk, fancy colour .	1	–

Weft.

Face yarn—		
Tint (1)	3	1
„ (2)	4	–
Backing and Spotting yarn—		
Tint (1)	4	3
Silk, fancy colour .	1	–

According to the first of these practices, a worsted cloth in mixture or plain yarns is woven, spotted with mercerized cotton, but in the second practice a double-plain cotton texture is made, checked in the ground on the face, and woven in one colour on the back, and spotted in single threads and single picks of silk.

CHAPTER IX

PRACTICE IN FIGURE DESIGNING

252. *Principles of Ornament.*—There can be no attempt made in this work to analyse the Principles of Ornament. They constitute a study in themselves which the student of decorative design needs to pursue concurrently with his training in textile technology. Some of the fundamental features of the subject may, however, be outlined, especially as they obtain in historic and modern styles of figured woven manufactures, and as they relate to high-class dress fabrics.

Nature, as illustrated in plant life, is a constant and illimitable source on which textile pattern origination draws. Loomwork, in the facilities and flexible technique it offers, as understood in the practice of interlacing threads of warp and weft, lends itself to the production, in a textural result, of the multi-variety of decorative units which natural forms possess and suggest.

Historic specimens demonstrate this idea, which is alike

emphasized in ancient Egyptian, Byzantine, and Grecian textiles, the surface of which is embellished with decorative work, inspired by or derived from the stem, leaf, and flower formation of the lotus, the iris, and the vine.

The damasks, brocades, velvets, and embroideries of the Sicilian, Florentine, Venetian, and Genoese worker of the twelfth to the sixteenth centuries, are masterpieces in the selection and grouping of animal, bird, plant, and flower features. The ornamentation is conceived and drafted on conventional and traditional lines, and on such principles of looming as subsist in the specimens reproduced in Figs. 278, 279, and 280. In addition to the decorative types here exhibited, in the ogee and medallion patterns of this school of woven design, fruit forms, particularly of the pomegranate variety, freely occur.

253. *Sicilian, Florentine, and Genoese Specimens.*—Early Sicilian textures not infrequently bear the impress of Eastern influence, both in decorative structure and in style composition. Thus, in Fig. 278, Arabic lettering is inserted in the panels, and a running border of Persian extract is introduced, while the method of treating and distributing the bird and animal types are peculiar to Eastern conception. Apart from the historic significance of this twelfth century specimen, the design is suggestive of true textile craftsmanship. The framework of the "repeat" is skilfully devised; the larger figures are consistently grouped with the central flower and leaf ornamentation; and the intermediate or ground spaces of the pattern are vigorously decorated.

Fig. 279 is of a later date, and texturally of the Genoese character. Here the decorative quality is enhanced by the looming practice followed, inasmuch as the figured sections are developed in velvet pile on a smooth warp-sateen surface. The ornament is partially geometric and partially floral in structure, with the flower and leaf details proceeding naturally from a central or parent stem. The "skeleton," or basic lines on which the pattern is elaborated, is that of constructing

FIG. 278.—SPECIMEN OF SICILIAN TEXTILE ORNAMENT.
TWELFTH TO THE THIRTEENTH CENTURY.

certain primary decorative elements, which are inverted or turned over in one section, and then transposed in position in making the "repeat" of the style. In these technicalities it is suggestive of the variety of patternwork derivable from a comparatively small number of design units by the basic plan on which such units are combined.

FIG. 279.—SPECIMEN OF GENOESE TEXTILE ORNAMENT.

In the third example, Fig. 280 (a reproduction by one of the authors of a sixteenth century silk brocade fabric, and woven in a 1200 Jacquard machine, with 160 threads and shots per inch), diversity of woven surface exercises a lesser influence than in Fig. 279, the pattern forms being forcibly expressed in the effects due to the contrast between the warp and weft sateen weaves employed in its construction. The weft weave

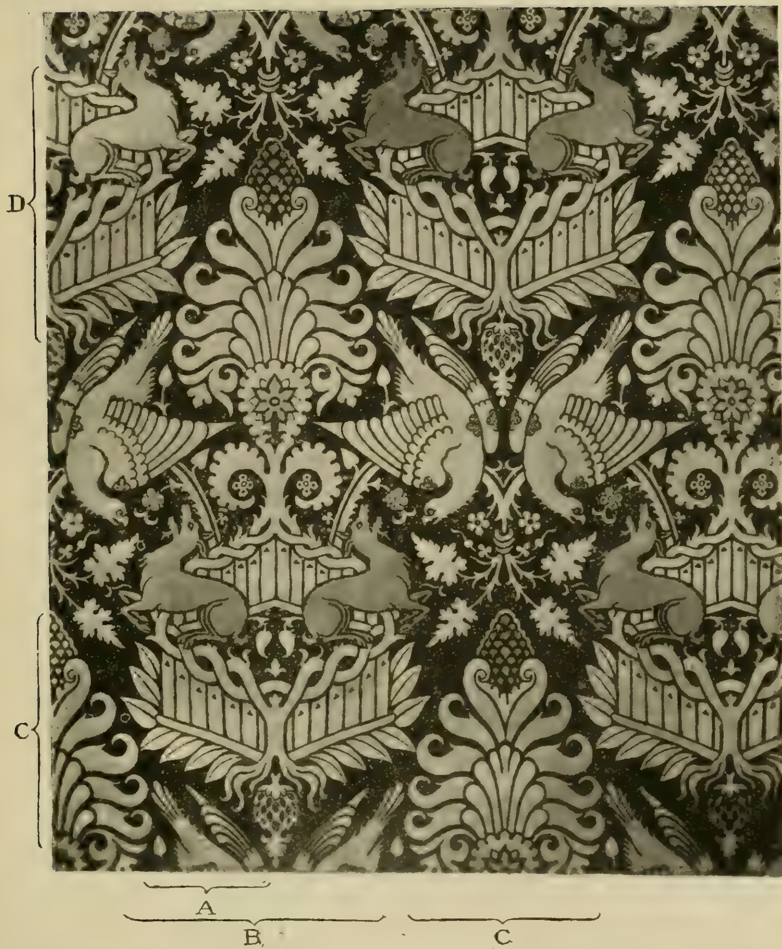


FIG. 280.—SICILIAN DECORATIVE SPECIMEN—13TH TO 14TH CENTURY.

appears in the figured sections, and the warp weave in the groundwork. To produce this texture with a plain or smooth surface, and the pattern in velvet pile, would unnaturally exaggerate the decorative types of which it consists; whereas, on the sateen principle of intertexture applied, the animal, bird, leaf, and conventionalized floral forms, inclusive of the geometric figurings, are clearly delineated in the fabric.*

Italian loomwork of the *Renaissance* is generally illustrative of surface decoration as a result of ornament acquired in textures perfect in structure; that is, in the setting and in the quality and counts of the silk yarns used, but in which the range in colour and in weave is somewhat restricted. The strength and character of the designs exist in the ornamental forms, from whatever source selected, and in the principles on which these forms are modelled and unified. The design qualities are acquired without having resource to shading and profuseness in colour tinting, which are apt to distinguish the efforts of the technologist who depends, too obviously, for decorative efficiency on these adjuncts in delineating and developing the component parts of a pattern.

254. *Oriental Designing Craft—Chinese and Japanese.*—Oriental craftsmanship (Chinese, Japanese, Indian, and Persian) is, on the other hand, more diversified and richer in colour tone. In the instance of the loom productions of China and Japan—woven, or woven and embroidered—the design

* In Fischbach's comprehensive work on historic decorative textiles—gleaned from various national and other museums—the examples in Figs. 278, 279 and 281 are shown printed in colour. Professor Roberts Beaumont, in a lecture on the "Sczepanik's Inventions—A Photographic Method of Preparing Textile Designs," given at a meeting of the British Association in Bradford, exhibited a number of early decorative fabrics, the designs for which had been produced and woven by this system. For this purpose photographs had, in the first place, been taken of the originals, and, in the second place, such photographs had been enlarged and transferred on to ruled paper, with the necessary weave units added, and without the work of technical draughting. From these photographically obtained point-paper results, the designs were stamped electrically for the loom.

In view of recent inventions said to have these objects in view, it may be stated that the Sczepanik's inventions and processes of work were successfully used, in the manner described, by Professor Beaumont in the early 90's.

treatment embodies plant forms as suggested in the foliage and flower of the peony, the chrysanthemum, the poppy, and in mimosa and fruit tree blossom. It is, moreover, cognizant of the value of form in decorative style as discoverable in such phenomena as the running stream, cloud masses and formation, and in the feathered and animal species. More especially is the Japanese craft worker a close observer and student of Nature. He adapts and utilizes, but at the same time he originates, combining, in his work, geometric with floral types, and exercising technique in translating these into textile decoration. The result is a species of woven art varied in colour tinting, and in structural anatomy, with the individual or integral elements of the pattern enforced by the weave units and colour tones applied.

Neither in the ornamentative nor in the colour scheme are restrictions observed. Where mechanical practices in weaving would limit, manipulative practices take their place. These characteristic features are evident in the decorative robe specimen, Fig. 281, varied in design and tinted composition to an impracticable degree in the use of automatic machinery. Geometric, in addition to floral decorative units, are here consistently associated. The hexagonal types are separately ornamented both in the ground and in their central figures, but are rightly conceived as a secondary feature in the design style. As in Western craftsmanship, the natural forms are strictly conventionalized; hence in the colour scheme applied in the weaving of this specimen, the geometric sections are developed in two tones of brown, of fawn, and purple, with the pattern diversified by interchanging the ground colouring in the panels, though developing their ornamental elements uniformly in brown and silver grey. Richer tones and tints are combined in producing the flower and the leaf ornamentation, the flowers being successively woven in light red and gold, purple and blue, and in two tones of salmon, and the leaves in pale gold, blue and green.

The weave structures fit in with the development of each

FIG. 281.—JAPANESE DECORATIVE TEXTURE.
(From a collection of Eastern Textiles compiled by Professor Beaumont.)

class of decorative effect, the ground—in silver grey—being in a fine warp twill, and the petals of the flowers, and also the leaves, in a full weft twill. To obtain the fast, neat decorative forms on the face of the cloth, the shuttling yarns employed are regularly stitched on the underside, necessitating the use of a supplementary warp for this purpose, which is skilfully utilized in imparting clearness to the weave units, and in imparting distinctiveness to the pattern outlines and details.

255. *Indian Loomwork.*—Indian loomwork is of a different category. In a sense it lacks, as compared with other Eastern styles of design, freedom of colour expression and breadth of ornamental treatment.

The former factor is contingent on the latter, inasmuch as range in colour is, in woven art, affected and controlled by the nature and diversity of the design characteristics. Pattern-work, inclusive of the different species of form gleaned from natural objects, presents possibilities in colour application of a more complex quality than patternwork composed of minute details and line effects, worked out on rigid and fixed principles of ornamentation.

Indian textiles of the Cashmere shawl description, are illustrative of a kind of trellis or fretwork design wrought in threads—a tracery or outlining of form rather than distinct figure production. The application of subdued hues and tints to this branch of woven design would render the details indistinct and blurred. Tone upon tone colouring, observed in Japanese styles, would be inappropriate in loomwork in which minuteness in the design features demands strong, pronounced colour contrasts; otherwise the beauty of the whole pattern would suffer. Colouring proceeds on lines and by methods adapted to the character of the ornamental factors. On this ground, Japanese textiles are alike typical of both toned and decided contrasts, and Indian textiles of the combination of positive and vivid colours.

Indian decorative textiles resemble hieroglyphic effects

woven in colour. Successive sections of the pattern are transcribed in brilliantly-dyed yarns, each section being in similar colours, but differently grouped or arranged. This enhances the diversity of colour blending, without adding to the number of distinct hues combined. Taking the historic pine form of figure, and producing it in black, white, red, blue, and green in the ground, and developing the design lines in red and blue, a diversified scheme of tinting is formed in three colours and white and black.

In the textile ornament of which the Indian shawl is typical, pattern is the result of a process of stitching or of colour insertion; for the yarns employed in producing the design structure are crossed in directions, agreeing with the form of the figuring, and not, as in weaving, at right angles with the warp threads. By adopting this system of textural colouring, the repetitions of corresponding parts of the style are definable in distinct varieties of colour arrangement. A modernized example of this design basis is given at Fig. 295, and treated of in Paragraph 268.

256. *Design Skeleton or Structural Base.**—Whatever the style of decorative design being originated, the particular form of "skeleton" employed is a fundamental and controlling feature. The term is used in defining the structural lines of the pattern, and those on which the decorative units—foliage, flowers, etc.—are built up and organized. It also determines the "repeat" of the design. Moreover, this basic plan, which may be geometric or partially so, or, as in a number of the Japanese and Chinese examples, a replica of the possible ornamental lines in the width of the fabric.

The geometric base demands that the decorative forms should be conventional in character; for a set, stereotyped "draft" is favourable to flatness of tone in the ornament, whether this be a composition of flower, plant, bird, and

* For studies in modern decorative design, see the admirable work, printed in colour, *La Flore Décorative*, by Henry Lambert; also Friling's *Modernflachornamente.*

animal types, or simply of plant forms. Similarly, a naturalistic design scheme necessitates a basis of construction which provides for a free and graceful grouping and disposition of the decorative lines and features. These distinctions in the

FIG. 282.—DESIGN CONSTRUCTED ON A GEOMETRIC "SKELETON."

"skeleton" selected for different styles of design are characteristic of the dress-fabric examples in the Figs. 282, 283, and 284, as well as of the historic specimens described. With geometric decoration, a mathematical formula should be followed, though it may be suggested by plant and floral details as in Fig. 282, a pattern comprising a central element

Fig. 283.—Conventionalized Foliage and Floral Design.

FIG. 284.—FOLIAGE AND FLORAL DESIGN—NATURALISTIC TREATMENT.

out of which the lines symmetrically develop, with four leading ornamental types—printed in grey tone—placed at equal distances from each other, and arranged on a diamond base. The more natural flower and leaf composition—Fig. 283—is developed on the "drop" and "turn-over" base, with suitable foliage filling in the ground area of the pattern. This is also the skeleton type applied in the origination of Fig. 284, consisting of delicate floral features, delineated in lines of a free and slender character.

The scheme of construction having been planned, the integral parts of the ornamentation, that is the flowers in Fig. 283 and the large leaves in Fig. 284, are outlined, and then the supplementary lines of the design added in a manner that links up the stems, leaf, petal, and other floral elements, into a compact decorative style.

The imaginative or creative skill exercised in this class of patternwork, differs in kind, but not in principle, from that observed in decorative textiles of the Renaissance period. The latter, as pointed out, are formulated on a fractional ornamental factor, complete in itself, which, by transposition in the width, and in some specimens in the length, acqruies decorative force and unity. The initial or created ornament in Figs. 278, 279, and 280 is comprised in the features bracketed B. The method of casting or framing develops a pattern "repeat." First, the form units in section A are transposed on the dice or honeycomb principle of weave origination—Fig. 91—and second, the compound decorative type thus drafted—included in bracket B—is centrally placed in the area of the pattern, or the two compound units are so arranged that the lower portion of the ornament in C fits in with the upper portion of the ornament in D, Fig. 279. Balance of figure distribution is dependent on the character of the grouping of the ornamentative types so classified—as in the mosaic weave designs in Figs. 258, 261, 262 and 263—and also on the intermediate scheme of decoration which fashions these types into a complete design.

257. *Textural Dimensions of Antique Decorative Patterns.*—Technically, the constructive plan in the early Italian examples is reducible to the simple principle of double-point "drafting," which multiplies the harness capacity, quadrupling its range. Thus, if the harness should be tied up on this system, and 200 tail cords (draw loom, pressure-healds mounting) should be employed in the weaving of section A—Figs. 278, 279 and 280—and each mail in the harness should actuate five threads (drawn in one mail and separately healded in the shafts), this section would contain 1,000 threads. Hence, by inverting the detail of which it is composed, and without adding to the cords (equal wires in the Jacquard machine), the compound section B would contain 2,000 threads. For section C, a further complement of 200 tail cords would be necessary, so that a full repeat of the pattern would contain 4,000 threads, or, with 160 ends per inch, it would be twenty-five inches in width.

258. *Material and Texture.*—The class of material applied, the fineness of the warp and weft threads, and the weave structure of the fabric, are obviously technicalities which restrict or expand the possibilities in the delineation of decorative ornament in the loom. The sketches in Figs. 282, 283, and 284 may be considered in illustration of these weaving essentials. Differing in quality and in decorative style, to reproduce them in one build of fabric would be an unsatisfactory process. The severer geometric pattern—Fig. 282—is producible in ordinary setting and weave units, but the involved interlacing leaf forms, as well as the practice in drafting the flowers in Fig. 283, necessitate fine setting, and the use of fine counts of yarn, with the use of weave units strongly in contrast. Further, to interpret correctly the delicate outlines and formation of the flowers and foliage in Fig. 284, the build of the fabric needs to be two-ply, or diversified in the types of weave applied to each species of ornament. The methods of looming described below, are suggestive of the principles of work to be observed in

transferring the sketches on to point paper, and in producing the designs in the woven fabric—

*Fig. 282.—Union Dress Texture

Warp.

2/60's cotton, 40's reed 2's.

Weft.

176 denier artificial silk, 80 picks per inch.

Weave Units.

Ground section = plain.
Features in grey = $_{2}^{1}$ twill.
„ „ black = 5-end weft sateen, and weft twills, varying in intersections from three to seven.

Fig. 283.—Spun Silk or Mercerized Cotton Texture

Warp.

2/80's counts, 120 ends per inch.

Weft.

40's counts, 120 picks per inch.

Weave Units.

Ground section = 5-end warp sateen.
Figured section = 5-end weft „

Fig. 284.—Cotton and Silk Union

Warp.

1 thread of 60's 2-fold silk.
1 „ „ 2/40's cotton.
1 „ „ 60's 2-fold silk.
144 ends per inch.

Weft.

1 pick of 30's silk tint (*a*).
1 „ „ „ „ (*b*).
140 picks per inch.

Weave Units.

Ground Section = repp in silk warp.
Figured Section: Stems = solid weft floats in tint (*a*).
Outlines of leaves and flowers and also veins in the flowers = solid weft floats in tint (*b*).
Leaf and flower veins = weft sateen and weft twill in tint (*a*).
Veins of large flowers = warp repp like ground sections.

* Figs. 282, 283 and 284 are reproductions of original designs by Messrs. F. Pemberton, W. Clough, and Julius Job, late students of Professor Beaumont.

In these looming practices, it will be observed that the simpler variety of design—Fig. 282—is producible in an elementary warp and weft setting and in common plans of weave. The difference in effect between the cotton warp effects—plain intersected in the ground—and of the silk weft effects—in twill and sateen in the figuring—develops this variety of pattern satisfactorily. With the decorative features in a flat tone, as in Fig. 283, the warp and weft yarns may be of similar counts, but one yarn two-fold and the other single, or one yarn firmer and less diffusive in quality than the other, and with the weaves, combined for ground and figure respectively, the reverse in warp and weft intersections respectively. In the instance of the ornament being composed of fine lines and details, as in Fig. 284, the textural build requires to be modified accordingly, employing two kinds of yarn in the warp, and one or two sorts of yarn in the weft. This style of figuring is not adapted for reproduction in the kind of looming principles indicated for Fig. 281. A distinctive ground weave, is, in the first place, essential, and in the second, the decorative elements require to be woven in two tints of weft yarn, with, if the sketch is to be faithfully followed, the veins in the larger leaves developed in a similar ribbed crossing to that forming the ground of the texture.

259. *Setting and Pattern Scale.*—Pattern clearness, fineness, and definition, are determined by fabric setting as by fabric structure. The setting practice also fixes the dimensions of the pattern in the fabric. In the settings for these examples, the pattern in Fig. 282 would be $4\frac{4}{5}$ in., and in Figs. 283 and 284, 5 in. in width, in Jacquard machines of 384 wires for the first, and of 600 wires for the latter. Increasing the fineness of the set without adding to the capacity of the Jacquard, would reduce the size of the pattern in the fabric, and would cause the detail to be less distinctive; and in Figs. 283 and 284 the ornament would suffer in textural delineation. On the other hand, practising more open setting in such harness mountings, would enlarge the dimensions of

the pattern, and have the effect of rendering the ornamentation coarser in quality.

It should, however, be explained, that finer settings may be practised in higher counts of yarns, and in a proportionately larger Jacquard machine, and the scale of the patterns retained

FIG. 285.—SILK-FIGURED TEXTURE—REPP GROUND.

Other schemes of warping and wefting, and of weave combination than those indicated, are also applicable. Thus, Fig. 282 is suitable for textural development in the build of fabric illustrated in Fig. 285 by applying the Ottoman rib in this specimen to the groundwork of Fig. 282, the fine rib to the sections in grey, and the weft interlacings to the sections in

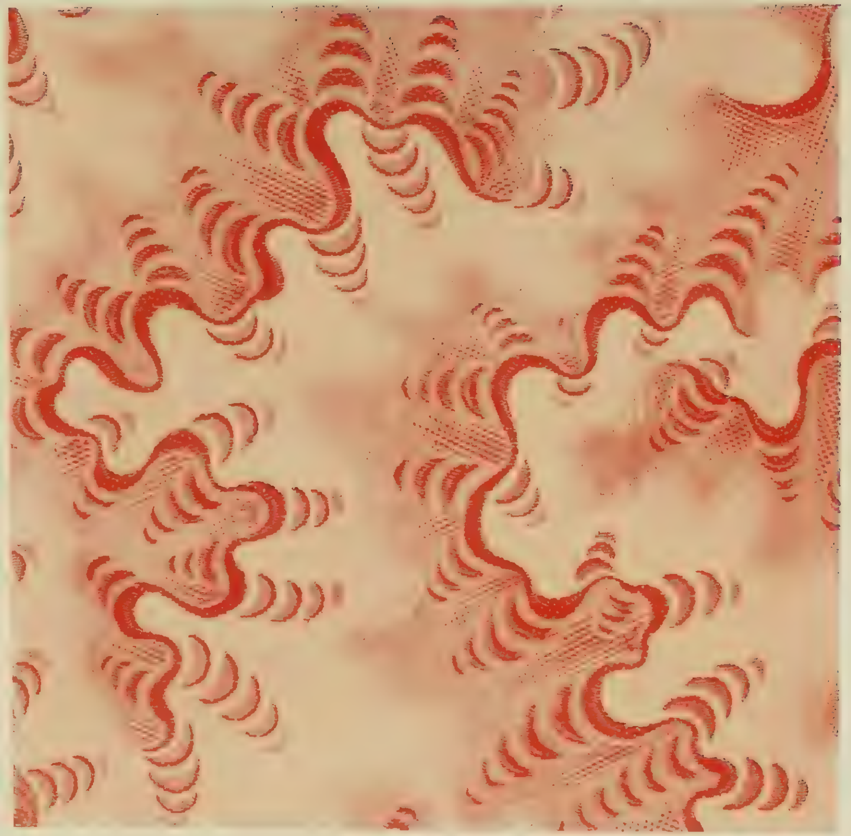


FIG. 286. FIGURED SILK—GROUND DEVELOPED IN WARP SATEEN, WITH FIGURED FEATURES IN WARP REPP, FLOATED WEFT AND SHADED TWILLED MAT.

black. The loom setting would, in this adaptation, be altered to accord with the weave structures, arranging the warp two threads of 120's two-fold silk, and one thread of two-fold 60's cotton, and the weft two picks of 60's silk, and one pick of 30's cotton. Fig. 284 is likewise weavable in other systems of looming than that specified, as, for example, in the textural types illustrated in Fig. 286, by substituting—

(1) The warp sateen in Fig. 286 for the repp in Fig. 284.

(2) The repp in Fig. 286 for the weft sateen in Fig. 284.

(3) The shaded effect in Fig. 286 for the weave in the veins of the leaves in Fig. 284; but retaining the outlines and surface markings in the petals and flowers, in floats of weft.

260. *Transference of Sketch on to Point Paper.*—In transferring the original sketch on to point paper, the set and build of the fabric, and the capacity of the Jacquard have to be taken into account. Assuming the sketch to be that in Fig. 287, it is required to produce the design—first, in a dress fabric, with a cotton warp and silk weft, and with 80 threads and picks per inch in the loom; and second, in a double-weave worsted costume with 96 threads and picks per inch, and with 288 working wires in the Jacquard machine. This would give in the first texture a pattern of $\frac{288}{80}$, or of $3\frac{3}{5}$ inches.

For the accurate drafting of the sketch, it is usually divided into a number of rectangular sections divisible into the number of large squares in the looming plan. The width of the design in this case being limited to 288 threads, the point paper would contain 36 × 48 demarcation squares. The convenient number into which to divide the sketch is, therefore, 12 × 16, which gives each section equal to 24 threads and picks on the point paper, so that the portion bracketed A in Fig. 287, when transferred on to point paper, occupies 96 threads and picks. In working out this part, the ■'s in Fig. 287A correspond to the figuring in black, and the sections marked in ⊡'s to the figuring in grey in Fig. 287. Thus prepared, the design simply represents the correct enlargement and transference of the sketch on to the ruled paper.

To develop the design in the two textures specified, after thus outlining the pattern, the weaves would be applied.

FIG. 287.—DESIGN SKETCH PREPARED FOR POINT-PAPER DEVELOPMENT.

For the union dress, the ground would be plain, the details in ⊡'s in sateen, and those in ■'s in weft twill. For production in the double-plain cloth, one weave would be applied to the rosette figuring, and the reverse weave to the leaf features.

Colouring one thread of shade (1) and one thread of shade (2) in both warp and weft, would therefore give the grey forms in Fig. 287 in shade (1) and the other decorative forms in shade (2). In order to differentiate between these two figured types, the ground of the fabric would require to be in an intermingled

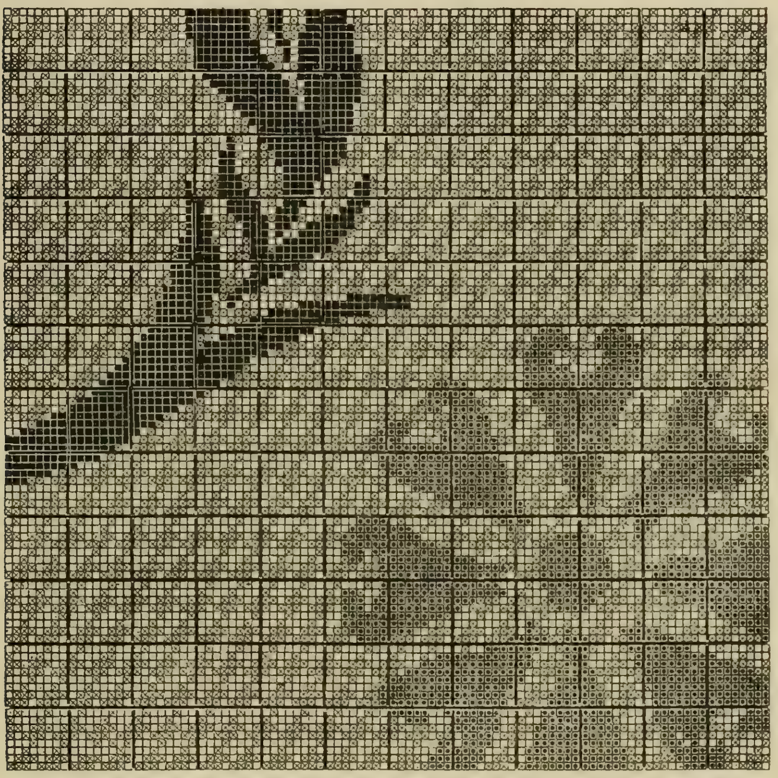


Fig. 287a.—Section of Looming Design for Fig. 287.

shade, so that a weave would have to be used in the groundwork of Fig. 287a, of a similar type to that marked in ☒'s.

The designing practice described is pursued in preparing and transferring the sketch of each class of decorative style on to point paper, as may be further shown by reference to the drafted harness pattern in Fig. 288. Here each repetition of

the pattern in the width of the fabric would comprise the features in sections B and B′, grouped on either side of the ornamentation in sections A and C, for the system of drafting the harness in a 384 wire machine, would cause—

Neckbands Nos. 1 to 192 to correspond to Threads 1 to 192 in the looming design or to Section A in Fig. 288.
,, ,, 193 to 288 to correspond to Threads 193 to 288 in the looming design or to Section B in Fig. 288.
,, ,, 289 to 384 to correspond to Threads 289 to 384 in the looming design or to Section C in Fig. 288.
,, ,, 293 to 288 to correspond to Threads 385 to 480 in the looming design or to Section B′ of Fig. 288.

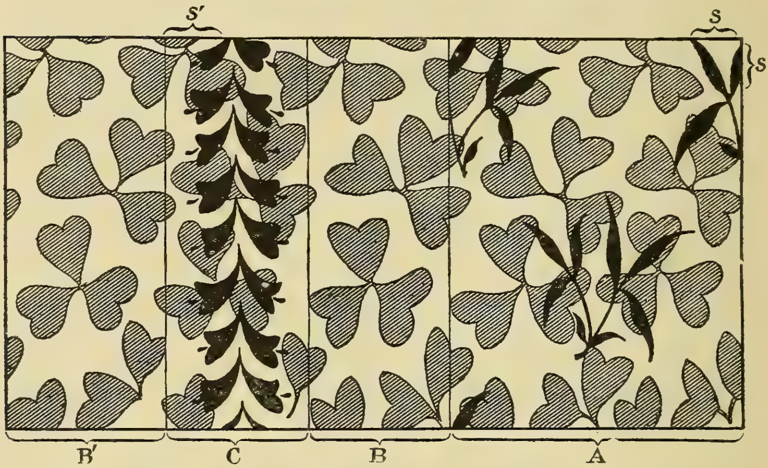


Fig. 288.—Design Sketch for Drafted Harness-Mounting.

This principle of harness mounting repeats certain decorative sections in specified order in framing the complete style, so that in a sense it both restricts and expands pattern origination. It fixes the constructive lines or basis of the design, and also inserts, in two or more positions, certain units of effect—Section B, Fig. 288—into each repeat of the style. The first provision renders it impracticable in designs occupying the full Jacquard capacity to modify the form of the style, which must be of a striped or rectangular structure, and the second enlarges the design as drafted for the loom.

The "tie-up" illustrated in this sketch demonstrates these

technicalities. It increases the size of the repeat of the pattern, but it also limits the field in pattern invention to striped surface decoration. Yet in rendering parts B common to each section of the style the decorative scheme is clearly elaborated. For subduing or neutralizing the line definition, which tends to divide up patterns thus constituted,

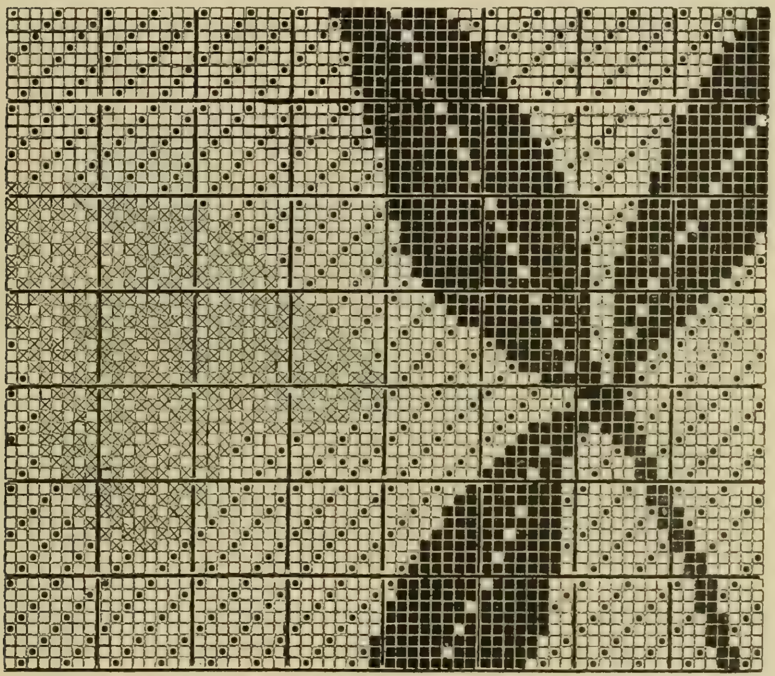


FIG. 288A.

it is a useful plan—as in Fig. 288—to run one description of figuring uniformly through each section. By this practice, an " all-over " form of decoration is combined with pattern types of a special character, and arranged on a drop, rectangular, or " turn-over " principle.

To work out the sketch for card stamping, it is only necessary to transfer parts A, B, and C on to point paper, sub-dividing these into equal squares—parts A into 12, and parts B and

C into 6 in the width—so that each square would be equivalent to 16 threads and picks in the looming plan. Providing it should be intended to differentiate the pattern forms in A from those in B and C, then the ground weave in the respective stripings would be varied, and also the weaves applied to the figured effects printed in dark tones. Two methods of preparing the sketch may be suggested: first, the development of the leaf details in warp intersections, with the surface figuring, in parts A and C, in weft intersections, in which case

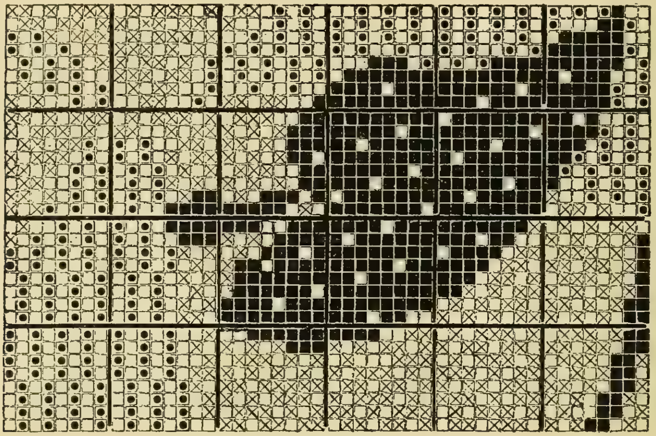


FIG. 288B.

the ground weave would require to flush the warp and weft equally on each side of the cloth. Second, the method illustrated in the sectional plans—Figs. 288A and 288B—in which the ornamental types are produced in weft, and the groundwork in warp-face weaves.

Only the portions S and S′ of Fig. 288 have been treated. In order to emphasize the common relation of the shamrock pattern to the supplementary design features in sections A and C, it is developed in one type of crossing, namely, the diamond weave marked in ☒'s. In Fig. 288A the ground weave is $\frac{3}{1}$ twill, with the surface pattern in pronounced weft floats, but in Fig. 288B the ground weave is $\frac{4}{4}$ warp

cord, with the surface figuring in a 10-shaft weft sateen. This practice in looming would result in each kind of pattern-work being similar in tone and definition in the fabric as in the sketch.

261. *Structural Types of Figured Patterns.*—With a view of illustrating the practices in developing figured styles, the textural principles, applied in drafting the patterns on point paper and defined in Table XVI, will be dissected—

TABLE XVI

FIGURED FABRICS—STRUCTURAL TYPES

Fabric Type.	*Fabric Build.*	*Examples.*
1. Fabrics with Weft Pattern Features on a Common Weave Ground.	Single in Warp and Weft	Figs. 213, 214A, 262, and 289
2. Weft Figured Fabrics with a Warp Sateen Ground.	ditto	Figs. 290 and 290A
3. Sateen Figured Textures.	ditto	Figs. 266 and 280
4. Sateen Make of Figured Fabrics—Fine Structures.	Single in the Warp and 2-ply in the Weft.	Figs. 3, 291, 291A, and 292
5. Extra Warp, Weft, or Warp-and-Weft Figured Textures.	Two or 3-ply in either Warp or Weft.	Fig. 294
6. Figured Double-weave Textures.	Compound in Warp and Weft.	Fig. 297
7. Reversible Figured Fabrics.	ditto	Figs. 298, 298A, 299, and 299A
8. Multi-Weft Figured Structures.	Single in the Warp and Multi-fold in Weft.	Figs. 295, 295A, 296, and 296A
9. Compound Figured Structures.	Multi-ply in both Warp and Weft.	Figs. 300, 300A, and 301.
10. Warp Figured Matelasses.	Compound in the Warp and Single or Two-ply in the Weft.	Figs. 302, 302A, 303, 304, 304A, and 305
11. Fabrics with Shaded Figuring in Weave and Colour.	Single or Compound in Build.	Figs. 306, 307, and 308A

Efficient practice in figure designing is closely allied with the mastery of the principles of pattern origination as exemplified in "Weave Compounds," and in "Spotted and Mosaic Structures." Thus, the dress design in Fig. 213 is illustrative of the weaving technique applicable in producing

pattern units of a diamond character in a plain-woven texture, with the integral sections of the simple decorative scheme expressed in weaves differing in the dimensions of their weft intersections. Or, to take Fig. 220, it is suggestive of line and form definition obtainable in weft cord weaves, while in such examples as Figs. 215, 218, 222, and 223, it is clearly evident that "weave" structures may be utilized in acquiring different types of pattern development.

In the mosaic group of styles, similar principles of weaving obtain, but in designs further elaborated in line structure, and constructed on rectangular, transposition, and curvilinear bases. Such pattern types as those in Figs. 253, 258, 262, 263, and 266 denote that different varieties of line and form grouping may be suitably defined on point paper, and, therefore, in the woven fabric. But correct drafting is essential, which involves weave units being selected and combined which distinctly bring out each species of effect of which the style is composed. Moreover, it was shown that in spotted and mosaic figuring, certain features are producible in extra warp or weft yarns—Figs. 270, 271, and 273—or in double weaves, as in Figs. 275 and 276. It is these fundamental and varied systems of looming, and of fabric structure, which, in a modified and elaborated form, are employed in originating styles of a figured or decorative category.

262. *Weft Figuring on a Common Weave Ground.*—Many styles of figured patterns are woven on this principle. The pattern elements are constructed in compact floats of weft yarn, twilled, or regularly stitched; or they are produced in different classes of weave. Fig. 289 is a typical structure applicable, first, to silk fabrics; second, to union textures having a cotton warp and lustre weft yarn; and, third, with the broader figured details woven in sateen, to worsted textures. The scroll work is suggestive of the running form of simple ornament, which is frequently introduced into this variety of design, and woven in a firmer and faster plan of intersection than the more prominent parts of the pattern.

In working out the style in a silk or artificial weft texture, the figuring, formed in twill and in floated shots, might be chintzed in the shuttling. Applying it to a worsted costume, and retaining the plain make in the ground, the prunelle twill in the scroll, and developing the leaf decoration in a 4-end

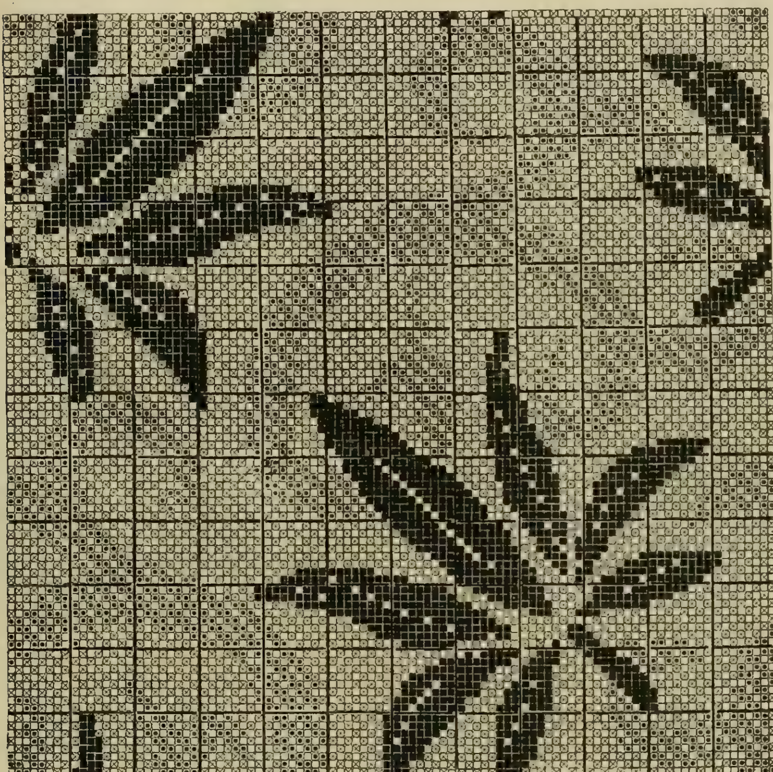


FIG. 289.—WEFT-YARN FIGURING ON A PLAIN GROUND.

sateen—the design would be adapted to 2-and-1 colouring in the warp and weft. The use of light and medium shaded yarns so arranged, would give the groundwork in the light shade, with minute line details in a medium shade, the scroll in hair-line effects in the two shades, and the stem and leaf forms in mixture tones.

263. *Sateen Pattern Production.*—Sateen weaves—warp and weft structures—have been treated of in originating designs on checked, mosaic, and waved bases, and their application to decorative textures has also been analysed. When the styles of ornamentation consist of simple lines and fine detail features, they are weavable in flushed shots of weft. A specimen of this description of patternwork is sketched in Fig. 290, for which a looming section is given in Fig. 290A. This practice is followed in the production of light blouse textures and fabrics of a Japanese character. It is not,

FIG. 290.—LEAF PATTERN FOR WEFT-YARN FIGURING.

in all points, technically satisfactory. It emphasizes the pattern types distinctly, but, as the warp yarns float loosely underneath the weft figuring, the fabric build is not perfect. Moreover, the bolder the development of the decorative details, the less suitable becomes the reverse side of the texture. By the insertion of stitching points as seen in certain of the fuller leaf forms in Fig. 290A, this defective feature is eliminated in some degree, but the frequency of the ties so inserted is liable to detract from the smartness and precise definition of the surface pattern. Still, without close setting in the reed, such ties, in this example, would require to be

increased. For designs composed of minute elements producible in light dress and blouse stuffs, this principle of construction is useful, and especially should crêpe or fast weaves be substituted for the warp sateen used in the ground of Fig. 290A.

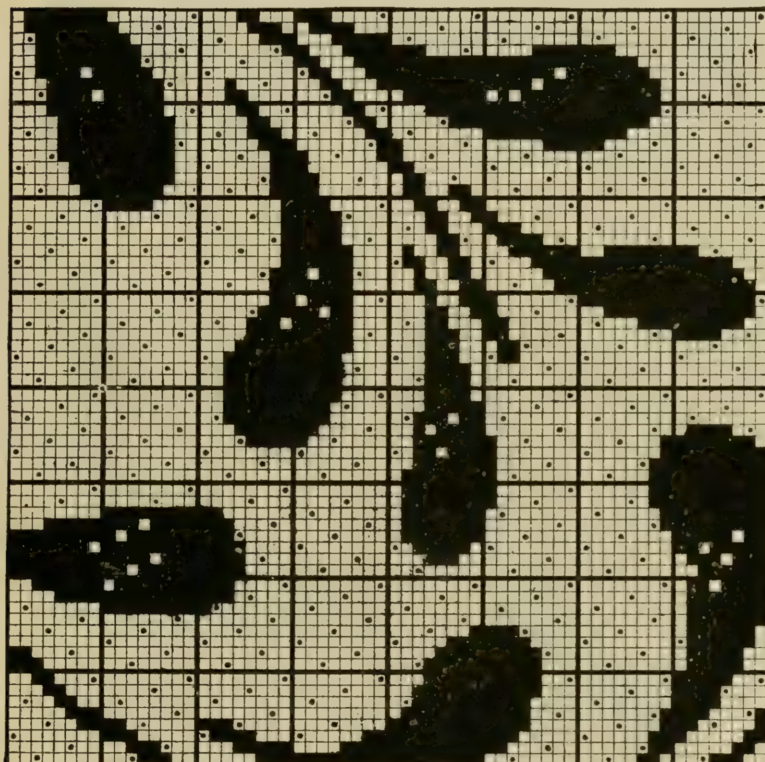


FIG. 290A.—(*Sectional design for Fig.* 290.)

A further build of sateen fabric is obtained by the methods of looming, illustrated in Figs. 291A and 292—sections of the point paper designs for the sketch in Fig. 291, and the silk satin in Fig. 3. Referring to Fig. 291A, the figuring shots are shown as distinct from the ground shuttling yarns. The latter, by interlacing sateen in the ground and plain under

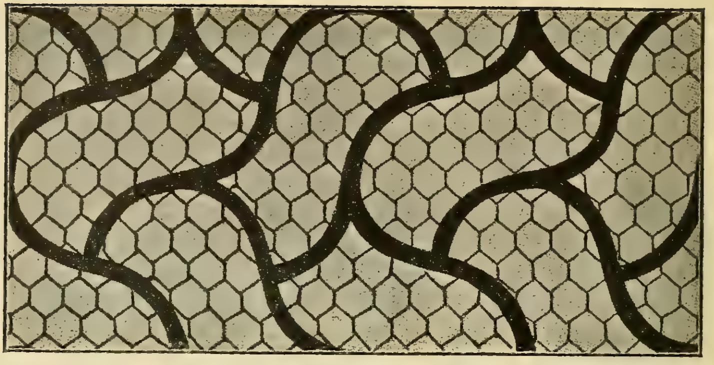


FIG. 291.—WAVED-FORM OF PATTERN WITH TRELLIS GROUNDWORK.

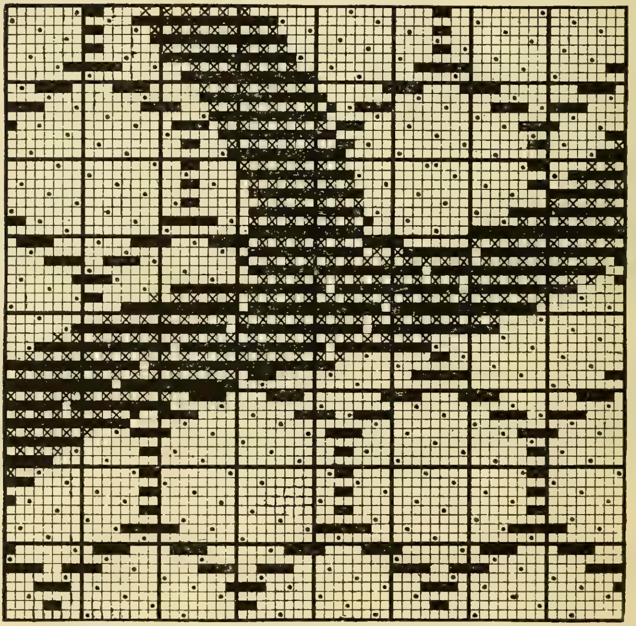


FIG. 291A.—(*Sectional design for Fig.* 291.)

the pattern lines, make the fabric structure. This is strictly a variety of semi-backed cloth, for on the reverse side of the effects marked in ■'s, a plain foundation is formed marked in ⊠'s, but this does not in any way impair the fulness and

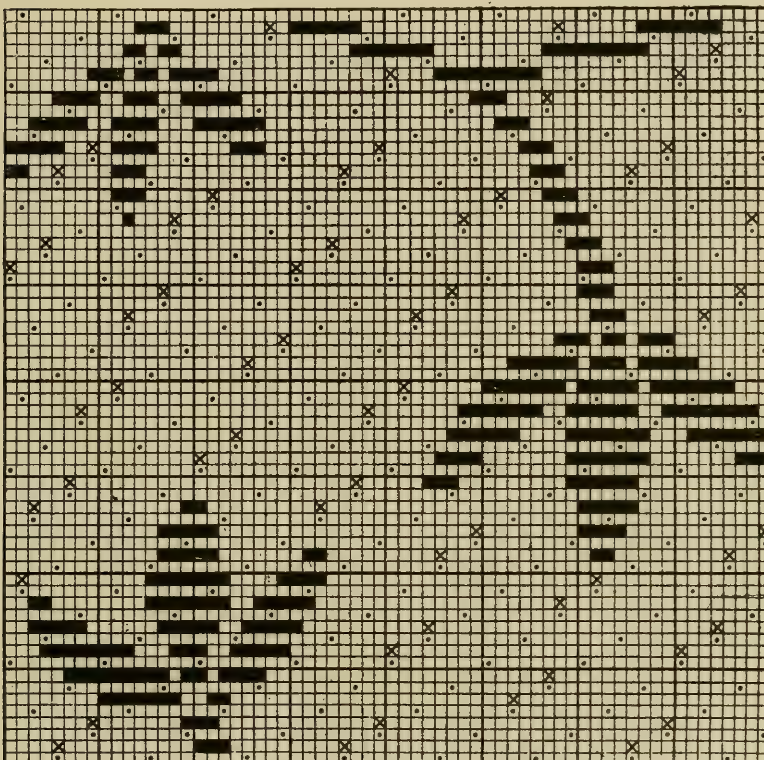


FIG. 292.—SILK SATIN STRUCTURE—WEFT ORNAMENTATION.

solidity of either the smaller or broader lines in the pattern. There is thus produced a fast-woven under surface in all parts of the figuring, adding to the wearable efficiency of the texture. The sateen runs regularly on both the ground and figuring picks throughout the whole design scheme. The result is a weft developed pattern on a warp sateen, but with

the addition of plain intersections under the pattern. Several practices in looming are feasible, two of which are as follows—

PIECE-DYED GOODS

Warp.

60's two-fold spun silk.

Weft.

30's spun or artificial silk.

110 threads and shots per inch.

COLOURED STYLES

Warp.

150 denier organzine silk shade (1).

(1) *Weft.*

1	pick of	215	denier	tram	silk	shade	(1).
1	,,	215	,,	,,	,,	,,	(2).
1	,,	210	,,	,,	,,	,,	(2).

(2) *Weft.*

1 pick of 210 denier tram silk shade (2).

140 threads and 130 shots per inch.

The first of these arrangements is for a silk production dyed in the piece; the second, in Weft I, for styles with the figuring in a different colour from the ground; and, in Weft II, for textures in which the pattern is acquired in quite a distinct colour from the effects in the warp yarns. Designs on the basis of Fig. 291, in which the field of the pattern is divided into geometrical forms, may be varied in weave structure, for such crossings as warp twill, diamond, and twilled mat may be applied to the units of effect in the ground. The weaves require, however, to be of the warp-face category, and to fit evenly with the sateen, otherwise they interfere with the distinctiveness of the decorative elements in the style.

264. *Pattern Diversification in Sateen Figuring.*—Providing these manufactures are not piece-dyed, diversity of style is obtainable in weaving in three ways, namely: (1) by a distinction in the colour tone of the warp and weft yarns; (2) by the formation of line stripes in the warping; and

(3) by chintzing in two or three colours in the weft. Considering the application of scheme (1) to Figs. 290 and 291, in originating a texture of a medium depth of colour, the warp should be in a lighter and the weft in a deeper tone. The sateen ground would thus be developed in the light colour, and the pattern features in a corresponding but deeper colour. For the second looming practice, the warp should be in two tints or tones, and the weft in a lighter or in a fuller hue for emphasizing the decorative features of the design. In the third practice, for giving effect to the chintzing, colours dissimilar in hue and also in tone should be selected. One of these should, however, link up with the colouring in the warp. Assuming, for example, the warp to be a rose tint, the wefts might be pale maroon and greenish lavender ; or, if the warp should be light fawn, suitable wefts would be tinted brown and turquoise blue, shuttling in such orders as 1-and-1, 2-and-1, 2-and-2, 4-and-2, and 4-and-4. The rule to be observed is, that with the colour units in too close a relation with each other in the chromatic scale, the characteristics, due to the chintzing, suffer ; whereas if the tone contrasts should be super-pronounced, the quality and style of both the design and fabric would be deteriorated.

265. *Fine Sateen Structures.*—To these, when made in silk, the term of "Figured Satins" is applied. In such manufactures it is essential to acquire a sound textile structure, and also to develop clearly the outlines and small effects of which the decorative style consists. Even the minutest details need to be smartly and distinctly brought out in the fabric, necessitating close setting in the loom, and the selection of weave units for the ground and the figuring in strong contrast with each other, such as a warp-face plan for the first, and a weft-face plan for the second factor.

Considering Fig. 3—page 11—in this relation, it is a simple line pattern composed of sprig, leaf, and floral forms in which, as seen from the sectional design, Fig. 292, an 8-end warp sateen is employed in the ground, and a special silk weft,

floated solid, in the weaving of the slender and delicate design features. Textural durability and firmness are attained by (1) the employment of two wefts—ground and figuring; (2) full setting in the sley, 340 ends and 160 picks per inch; and (3) the scheme of fabric construction. The ground picks are marked in ⊡'s, and the figuring picks in ■'s. First the foundation weft and warp threads make a fine fabric with a warp satin face, and weft satin back; and, second, the coloured weft produces (*a*) the pattern, and (*b*) a sub-tissue, or a regular twilled under-surface by interlacing with the warp in the order indicated in the intersections marked in ⊠'s. Structurally, it will be observed that this principle of design differs from that in Fig. 291A, for the figuring picks in the latter assist in weaving the 8-end sateen ground, but in this plan—Fig. 292—they give a different type of weave, and one which is formed on the sateen base. Here and in all classes of "satins," textural quality is the consequence of the fine setting, and of the types of weaves combined.

266. *Sateen Weave Figuring in Combination with other Weave Principles of Design.*—One example of this class—Fig. 293—will be described. It consists of two styles of figuring, that in section B, and that in section D, divided from each other by bands of warp twill, sections A and C. The decorative effects in B are woven in weft sateen on a warp-face ground, and those in D in floats of weft agreeing with the formation of the figuring lines. The surface ornament in D would be rendered a more prominent part of the design if it should be turned over and repeated, enlarging it to 96 threads. The design elements in B would, in this example, be flatter and more subdued in tone than those in D. Hence, in working out such designs for the loom, the textural value to be imparted to each grade of figuring is the factor which determines the kind of weave unit to employ. In assorting two or more decorative principles, if these are made into a striped style, they may—as in Fig. 293—be separated from each other by lines of effect in simple twills, or other weaves which fit

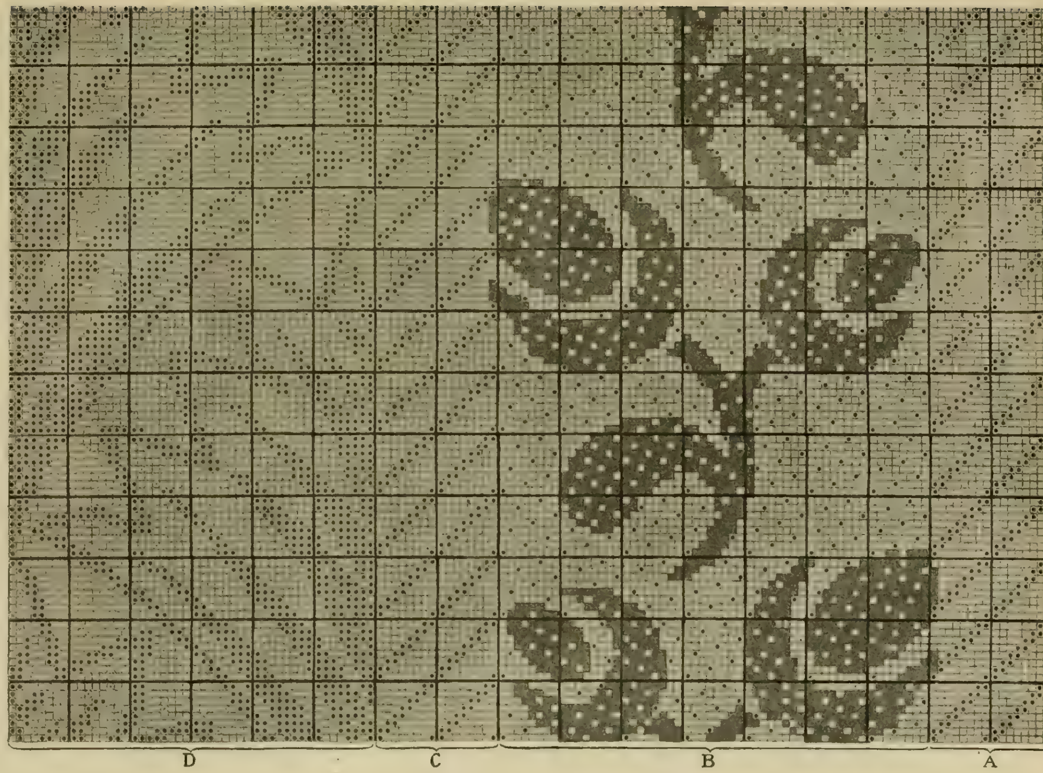


FIG. 293.—SATEEN AND TWILL FIGURING.

correctly with the sateen but also differ from it in structural effect.

267. *Form Definition in Extra Yarn Figuring.*—The use of extra warp or weft yarns in developing the decorative units enables the pattern outlines and forms to be forcibly emphasized and clearly delineated in the fabric. Such features being woven on this principle, in a special colour of yarn, they may be developed in solid floats or in distinct weave plans. This will be understood by assuming, in the first instance, that the decorative types in Fig. 294 are made in a fabric having one colour of warp yarn and crossed with a second colour of weft yarn, and single in build. This would be practicable by applying a plain or common weave to the ground, a weft sateen to the sections in dark tones, and a warp sateen to the sections in grey tones, when each would be distinct in effect, though somewhat indefinite in character. Substituting, in a second instance, a warp cord, two picks in a shed, for the plain, and producing the grey and black sections in two colours of weft, would, on the other hand, give the surface area of the texture in warp repp, and the figuring in different colours of weft yarn floated solidly or in twilled order. On this system, each pick in the design would be taken as equivalent to two shots of weft, so that, in card stamping, for the effects in ■'s, the grey would be lifted with the cord interlacings in the ground sections, and, for the effects in grey, the black intersections would be lifted, with also the cord in the ground—the two shots, black and grey, forming one line of the design, and one repp in the cord. Third, by warping one thread of grey and one thread of black, or in two selected shades, the design would be produced in extra warp, if opened out on the system of the examples in Figs. 268 and 270A. It is evident that, by either of the two latter systems of design construction, the leaf and other pattern elements would be more effectively developed than by the first principle, in which their delineation is the result of a difference in the weave units applied. The

extra warp or extra weft practice provides for this form of differentiation, plus that due to each species of figuring being woven in special coloured yarns.

268. *Figuring by Colour Insertion in the Shuttling.*—

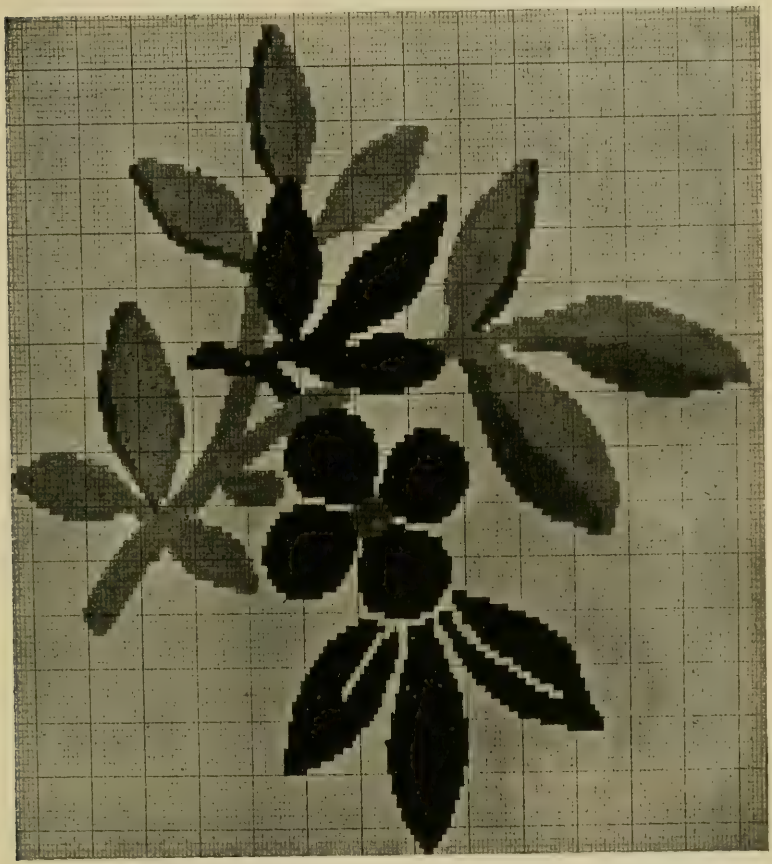


FIG. 294.—FIGURING BY EXTRA-WEFT COLOUR INSERTION.

Patternwork, by the insertion of coloured yarns, in the shuttling order of the fabric, is illustrated in Figs. 295 and 296. Both are modernized styles of woven ornament based on the pine figure, and also on the pine scheme of design formation. They suggest the principles of weaving and

colouring utilized in the manufacture of dress fabrics in which the warp yarns are chiefly employed in forming the groundwork of the texture, and in which the pattern lines and features are chiefly a product of the shots of weft. It is in this sense that the sectional plans, Figs. 295A, 296A and 296B, will be considered.

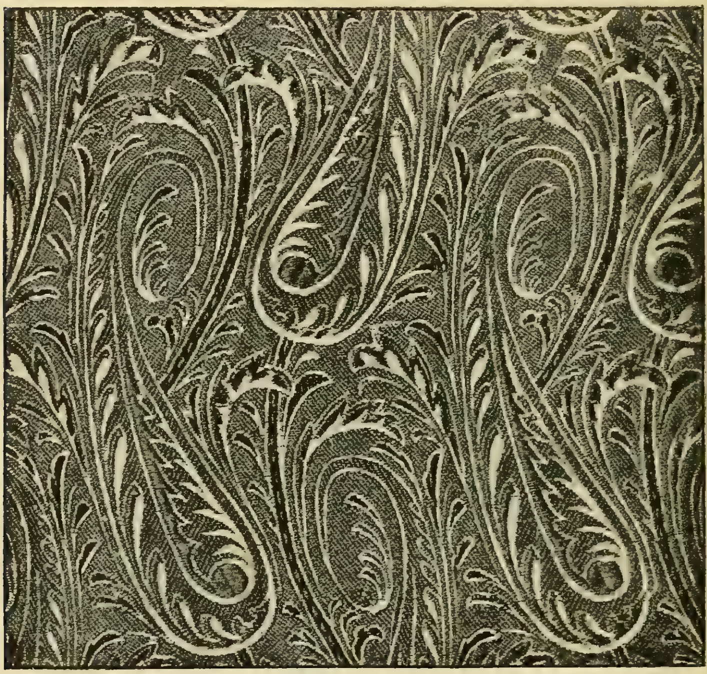


FIG. 295.—STUDY IN PINE FIGURING.

The conventional leaf forms add to the decorative effect in the former, and the diversity of weave units combined add to the textural quality in the latter. Fig. 295 is woven in one colour of warp yarn, and two colours of weft yarn picked 1-and-1. This arrangement simplifies the shuttling, and is made effective in developing the figuring by the system on which the colours are assorted in the looming design. The odd picks in Fig. 295A define the figuring when floated either

in weft cord or in weft sateen, as in section B. The even picks appear on the face in the cord sections, but on the back—stitched sateen—in the portions of the figuring formed by the odd picks. Both the odd and even picks produce a warp-sateen effect in the ground of the texture.

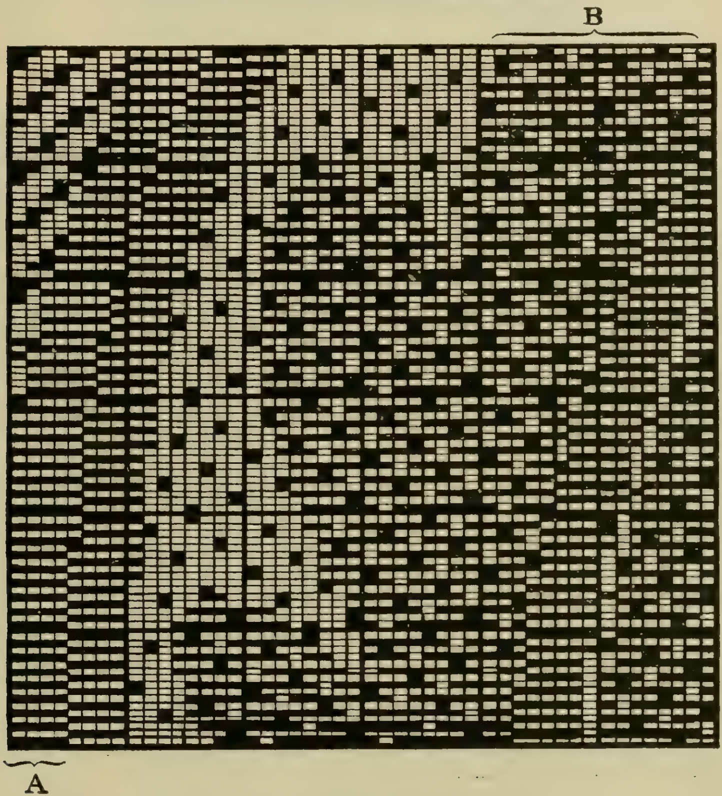


Fig. 295a.

In Fig. 296a both series of picks are shown, as arranged in the weaving of the fabric, but in the case of Fig. 295a, each type of effect is produced on the point paper as it would be developed in the loom. This pattern—Fig. 296—is illustrative of the richness of the decorative detail, developable in this class of designing and scheme of intertexture. Like Fig. 295, it is woven with two wefts, each intersecting

regularly with the warp yarns, one method of construction being—

Warp.

Blue or green 50 denier organzine silk
40's reed 3's.

Weft.

1 pick of brown 60 denier tram silk and
1 ,, ,, white.
240 picks per inch.

The weave elements in the design diversify the surface features of the fabric, producing this in successive sections in a sateen, twilled mat, etc. As the fabric is two-fold weft ways, each pick on the point paper represents two shots in the weaving. Thus, in stamping the cards, the picks would be arranged as seen in Fig. 296B, which is an extension of the first four picks of Fig. 296A. Where necessary, the ties (*a*) and (*c*) would be inserted in cutting the cards. These are introduced in a similar manner as in weft-backed cloths. As each weft is used freely on the face of the fabric, there being no large masses of either colour, very few ties or stitches are needed. In the sectional plans, the ■'s represent the white, and the ⊡'s the brown weft. As indicated, various crossings have been combined, including sateen, fancy mats, small spotted effects, diamond makes, and warp and weft twills running at various angles, adapted to the floral and other ornamental features of the style. The pattern consists of three principal pine figures decoratively interlaced. The spaces intervening the principal figures are filled in with minute spots and waved, ribbon-like lines. The specimen demonstrates first, the principle of acquiring pattern features in extra weft yarns; and, second, that of developing the ground features in weave units, contrasting in effect and fitting correctly one with the other.

269. *Double-Weave Figuring.*—While the double-weave class of fabric is, in some branches of textile manufacture, confined to the heavier descriptions of cloth, in the dress trade it is adapted to the production of light and even flimsy textures.

FIG. 296.—PINE PATTERN WITH DETAIL ORNAMENT IN THE GROUND.

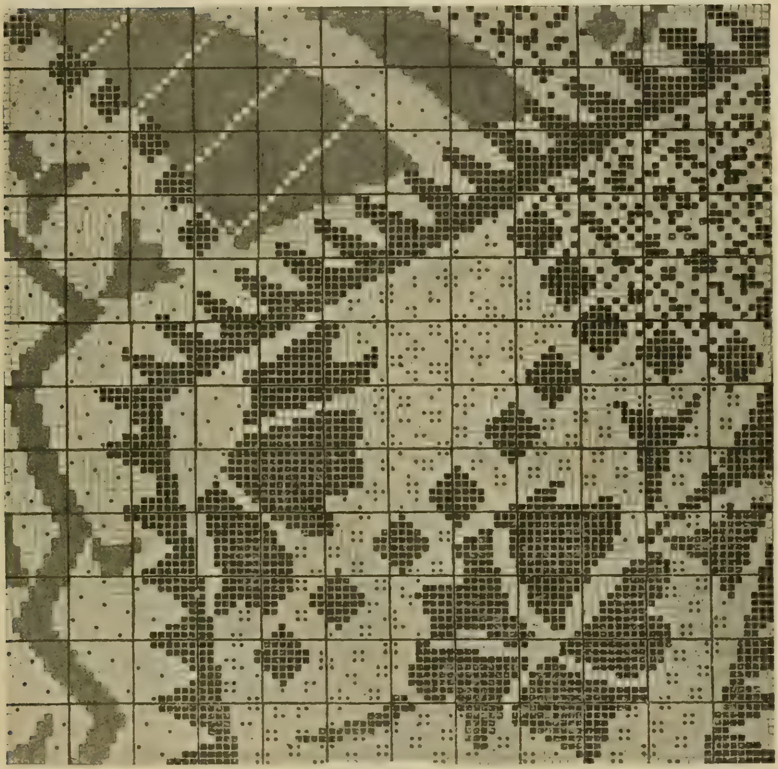


FIG. 296A.

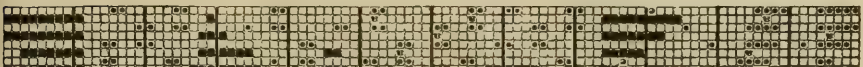


FIG. 296B.

The quality and counts of the yarn used, and the systems of setting practised, make it possible to employ compound weave structures in these goods without acquiring fabrics too firm in the handle or too thick in construction. As explained (Paragraph 248), these weave units give two or more layers of texture one over the other, but interchangeable in position. With the possibility of developing each single texture of which the compound weave is formed in different colours and qualities of yarn, it becomes practicable to use each type of single texture, as desired, in the ground or in the figured portions on the face of the cloth. This method of weaving is, therefore, applied first, to compound fabrics made of one sort of yarn and in one weave structure; second, to compound fabrics in which each unit texture is composed of different sorts of yarn, and formed in different weaves; and, third, in which the textures combined are dissimilar in colour, yarn quality, and in weave composition.

Three examples, illustrative of the designing scheme, are shown in Figs. 297, 298, and 299, made respectively in worsted yarn, worsted and mohair, and in silk and worsted. Fig. 297 is an ordinary double-plain structure. To produce the loom design for this specimen in a 192 Jacquard machine, the pattern would be sketched in colour on point paper, and weave (1) in plan A—Fig. 274—applied to the figured sections, and weave (2) to the ground. The specimen has been produced in 2/64's worsted, arranged, in the warp, one thread of light yarn and one thread of dark yarn; and, in the weft, one pick of light yarn same as the warp, and one pick of medium-shade yarn, with 84 threads and picks per inch. Had the same yarns been used in the weft as in the warp, the pattern details would have been more pronounced, with the figure in a darker shade. The pattern forms might be further toned or subdued by weaving with one colour of weft intermediate in tone depth between the two shades of yarn in the warp.

It should be observed that the double-plain make is the

best adapted compound weave structure for acquiring clearness in the design features, and it is for this reason employed in the production of "reversibles" in cotton, worsted, and silk goods.

The weaves are not necessarily constructed one thread and

FIG. 297.—DOUBLE-PLAIN WOVEN SPECIMEN.

one pick for the upper and lower textures alternately, but they may also be arranged 2-and-1, 3-and-1, etc. When combined on the latter systems, they are suitable for fabrics in which two thicknesses of yarn are used, one in the production of a fine, and the other in the production of a coarser texture, as illustrated in Fig. 298. The two textures are

again interchangeable from the face to the underside of the fabric in forming the figure and the ground respectively. The weaving data for this specimen are—

Warp.

1 thread of 2/72's worsted.
1 ,, ,, 2/50's mohair.
1 ,, ,, 2/72's worsted.

Weft.

1 pick of 2/72's worsted.
1 ,, ,, 18's mohair.

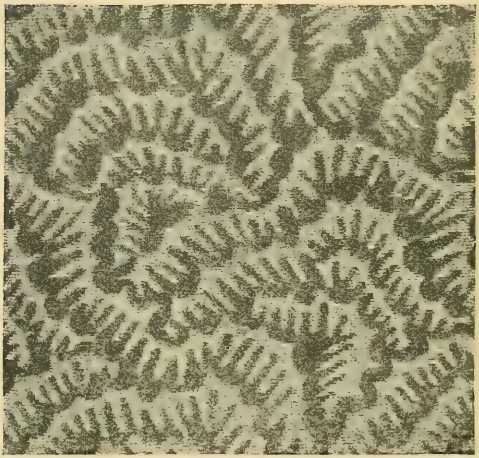


FIG. 298.—REVERSIBLE FIGURED TYPE—WORSTED AND MOHAIR YARNS.

The difference in the two materials employed in the weaving of this example, causes the effects in the mohair to protrude on the surface of the cloth. In some fabrics this filament quality is utilized in developing pattern work in a kind of looped, buckled, or curl effect. When this is done, the cloths are set sufficiently wide in the loom to allow of 15 per cent. to 20 per cent. of contraction in width in the scouring and milling processes.

Referring to the sectional plan—Fig. 298A—in which a part of the figure is sketched in grey, the mohair weft yarn

floats 5-and-1, or interlaces plain with every third thread in the design, the intervening threads making a plain structure through the cloth. When the mohair weft is producing the figure, the fine mohair threads in the warp are also floated on the face, whereas, when the ground is being produced, such mohair threads and picks float on the back. This build of fabric gives a compact solid figure in mohair weft—and one more pronounced in tone than would result if the texture were warped and wefted in the same order.

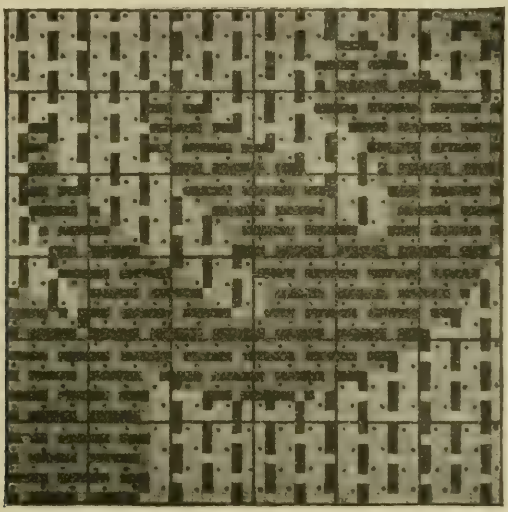


FIG. 298A.

In contrast with the comparatively firm grades of cloth in Figs. 297 and 298, the specimen in Fig. 299, composed of silk and fine worsted yarns, may be examined. Again the fabric is double in the weave, being formed of two perfectly plain structures, one made of silk and the other made of worsted warp and weft arranged thus in the loom—

1 thread or pick of 20 denier organzine in the warp and tram in the weft ;
1 thread or pick of 2/40's worsted ; and
2 threads or picks of 20 denier organzine in the warp and tram in the weft ; set in a 25's reed with 4 threads in each dent.

The plan of construction will be understood by a reference to Fig. 299A. Here the grey threads and picks lettered (*a*) represent the worsted portion of the pattern, which, being woven plain, make a foundation for the figuring. The silk threads also interlace in plain order, and the design effects are obtained by bringing the silk texture on to the face, which

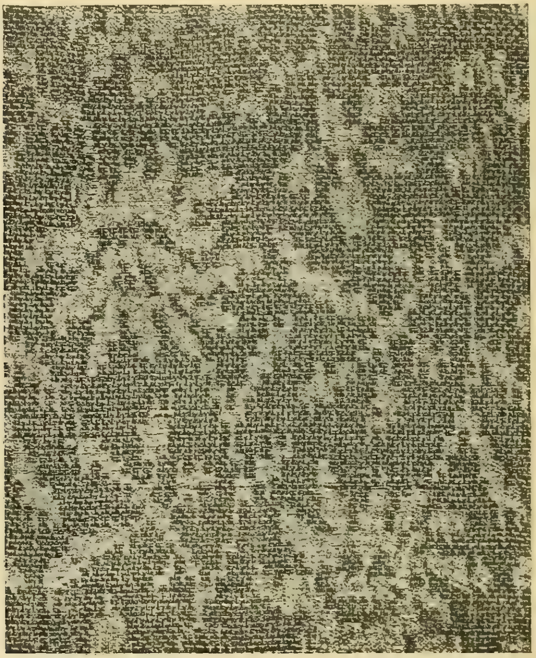


FIG. 299.—REVERSIBLE FIGURED TYPE—SILK AND COTTON YARNS.

conceals the texture made of the thicker yarn in the ground. In the figured portions of the design there are two separate or unstitched fabrics, and the looseness thus caused gives the silk a crinkled effect. Where no figuring is visible on the surface of the fabric, the plain silk structure is on the back, but here it is stitched regularly to the worsted yarn structure, and gives the delicate surface quality seen in the specimen. The tying or stitching in the ground is effected by allowing

one silk pick in every three to weave plain with the foundation threads. The picks selected for this purpose immediately follow the ground picks, and weave in exactly the same order. Though this is a union fabric (silk and wool) it only weighs a few ozs. per yard, 27 in. in width. In making designs for goods

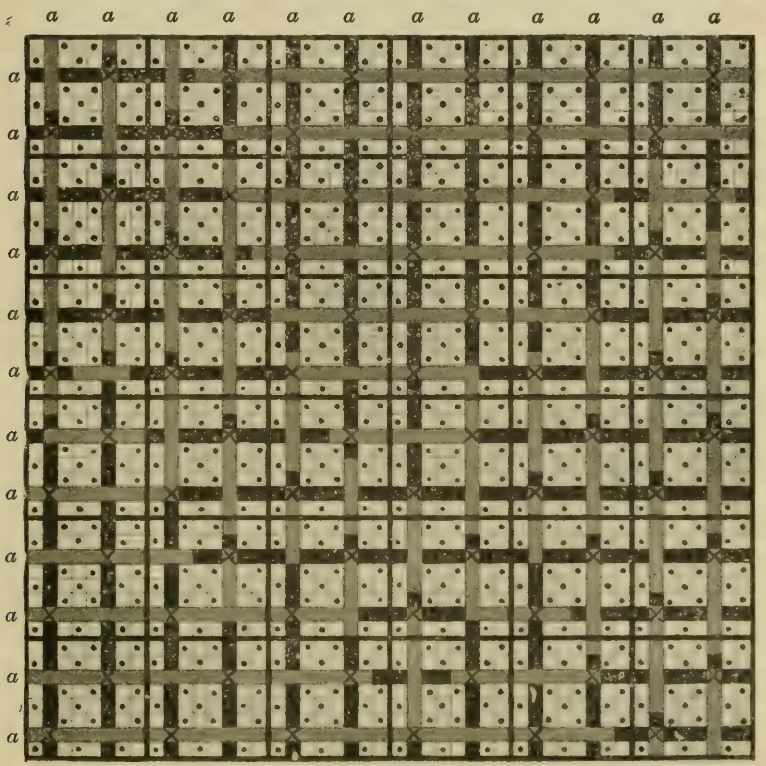


FIG. 299A.

of this class, it has to be borne in mind that the ornamental details require to be broad in character, inasmuch as patterns composed of fine lines and minute ornamentation are unsuitable for development on this principle of manufacture.

270. *Reversible Figured Goods.*—In producing the pattern features in double or compound weaves, the fabrics are reversible in colour and in surface features in both the ground

and the figured sections; for the different species of textural detail, whether due to tinting or to weave elements, are exactly transposed in position on the two sides of the cloth. Examining Figs. 297, 298, and 299, each specimen has precisely the same design and ground characteristics on the face and on the back, but with the yarns and colour units interchanged. In Fig. 297 the ground on the under side of the fabric is in the darker, and the figuring in the lighter shade; in Fig. 298, the ground is changed to the mohair, and the figuring to the worsted, texture; and in Fig. 299, the ground is changed to silk, and the pattern types to the more open texture formed in the worsted yarn, over which the fine silk texture is visible as in the groundwork on the right side of the cloth.

It should be noted that for making-up purposes this build and variety of fabric offers certain advantages. Both sides are usable, the one constituting the face, in the process of weaving, for the garment proper, and that constituting the under side for trimmings as in the collar, cuffs, etc. Particularly are these goods so applicable when produced in pleasing colour contrasts and tones in the ground and figured sections, as, for example, in Figs. 298 and 299. When the cloths—as in structures similar to Fig. 297—are differently treated in the finishing or dressing routine on the face and on the back, such as a "clear finish" on the former, and a soft "raised finish" on the latter, they are further enhanced in value for this method of garment making.

271. *Compound Figured Structures.*—Silk and fancy figured designs are variable in the types of compound weaves in which they are producible, and also in the sorts of yarn used in the warping and in the wefting. The reversible principle is formulated on the employment of two or several double or treble weave structures, each producing a like build of texture. The two textures so formed into one cloth may be light and dark in tone, as in Fig. 297; composed of two sorts of yarn as mohair and worsted in Fig. 298; or they may be produced in fine and thicker yarns as in Fig. 299.

Each separate texture in these specimens is plain woven. But it was shown in Paragraphs 248 and 249 that the weave units of such textures, in multi-ply cloths, may be different, and it is this structural principle in designing which enters into the

FIG. 300.—FINE-SET SILK STYLE.

build and ornamentation of certain figured and decorative fabrics of the variety produced at Figs. 300 and 301, and at Fig. 47. The weave units selected in the construction of the specimen in Fig. 47 are given at Fig. 47A, and comprise plan (a') weft surface and plain back; (b') and (d') broken sateen

surface and plain back; and (e') and (f') backed irregular cord, warp decorated. The textural surfaces resulting from such weave units are illustrated in the micro-photographic specimens in Figs. 48 to 51, and have been treated of. The practice here exemplified in combining compound weave units, is also characteristic of the examples in Figs. 300 and 301. It enables a fast-woven texture to be acquired, rich in decorative style, and developed in special types of inter-

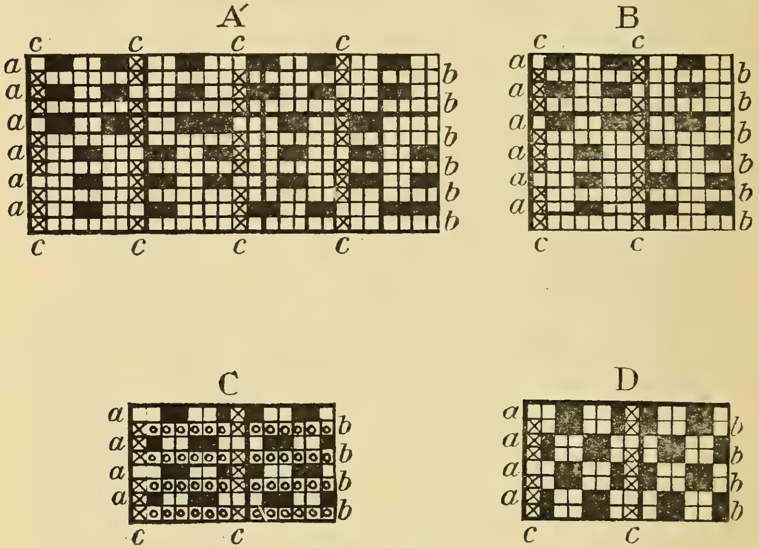


FIG. 300A.

texture. For example, in the "all-over" floral specimen in Fig. 300, the leaves and portions of the flowers are produced in warp repp effects, with the black outlines displayed on an evenly formed texture in silver grey. The warp threads (white, 450 per inch) work in pairs, every third pair being separated by threads interlacing singly, as indicated on the point paper plans by the lines in ☒'s. The figuring in white is produced in the two weaves at A′ and B, Fig. 300A. It will be seen that the first and every seventh thread form a plain structure on the back, as also in weaves C and D. The

warp for threads (*c*) is, therefore, drawn on to shafts, which produce the foundation part of the cloth. Further, in each weave two threads work together, and would be drawn in one mail of the harness. Picks (*a*) are black and picks (*b*) white. Plan A′ gives a waved repp and plan B a striped

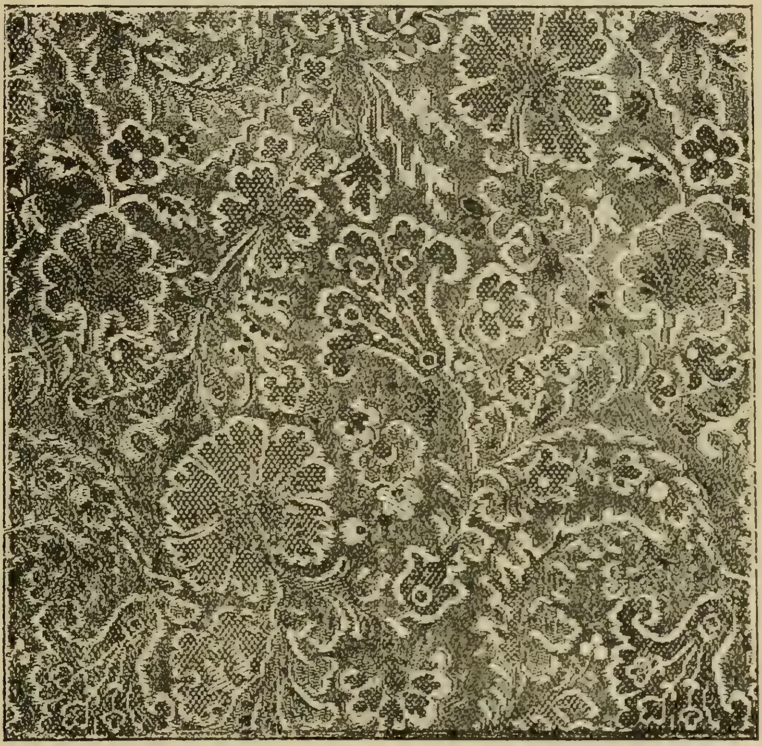


FIG. 301.—FIGURED SILK DEVELOPED IN COMPOUND WEAVE UNITS.

warp cord. The dark tones in the fabric are due to picks (*b*) floating on the surface, as shown in plan C. The effect in the ground of the texture is obtained by weave D, which by healding, as indicated, two threads in a mail, produces a warp cord. The fine-set fabric in Fig. 301 (600 ends and 250 picks per inch) contains other structural features. This specimen

is composed of the five weaves, A′, B, C, D, and E in Fig. 301A, and is coloured as below—

Warp.

900 threads.	2 threads of fawn silk, 1½-dram organzine. 2 ,, ,, light olive green silk, 1½-dram organzine.
700 threads.	2 threads of old gold 1½-dram organzine. 2 ,, ,, light olive green 1½-dram organzine.

Weft.

1 pick of dark olive green silk, 7-dram tram.
1 ,, ,, ecru silk, 7-dram tram.

Though the warp is thus arranged, decisive coloured lines are not noticeable in the fabric, for the flower and other details in the figuring are so distributed as to conceal the junctions of the stripings. The weaves are more of a weft-surface structure than in Fig. 300. In the ground of the texture—Plan A′, Fig. 301A—the green warp interlaces with both wefts to form the face, and the back of the cloth is made firm by the remainder of the warp threads intersecting with the ecru weft yarn. When either of the colours in the warp is used for the middle portions of the figuring, the weave plan applied is that shown at B, which, in most instances in the design, is edged by floats of either the green or ecru weft. When the former is floating, plan C is employed, but when the latter, plan D. For the inside parts of certain of the floral forms in which the ground weft floats solid, plan E is used, in which, as in A′, C, and D, the even picks interlace 4-and-4 on the underside of the fabric.

272. *Matelassé Principle.*—The matelassé principle of fabric structure forms one of the most useful varieties of figure designing. It obtains in both dress and decorative fabrics in light and medium weight goods. The textures, being fine-set in the warp, and open-set in the weft, may be economically woven. The pattern forms and lines—Fig. 302—are so clearly marked as to resemble carved work. This

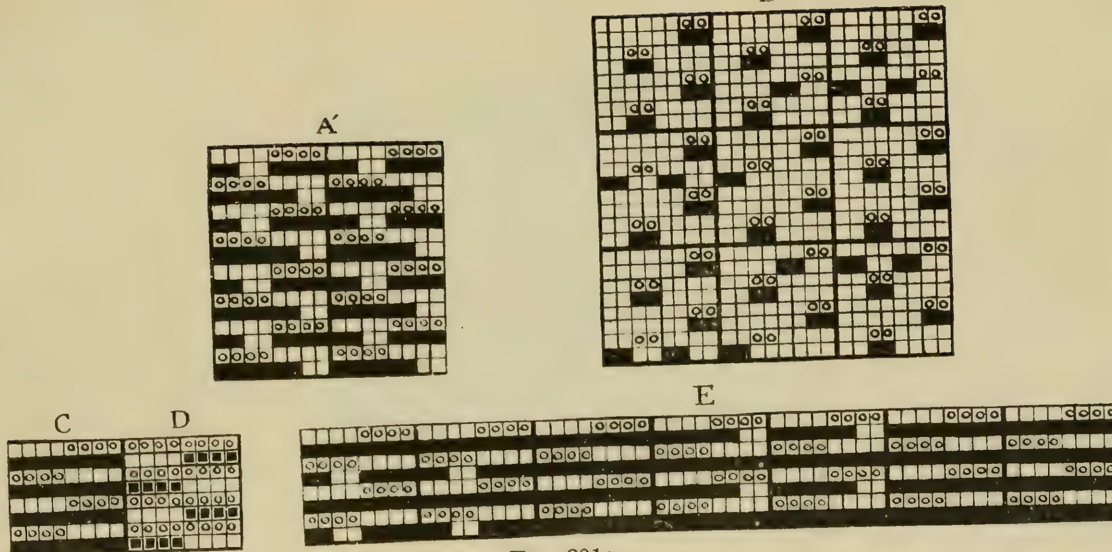


FIG. 301A.

distinctive quality of the surface ornamentation is accentuated by the relative counts of the warp and weft yarns, by close setting in the warp and loose setting in the weft, and by one series of picks acting as "binders," and a second series as "fillers." The "fillers" or wadding shots impart the raised or relief tone to the figuring, and the "binders" knit the outlines of the design into the foundation of the cloth. The specimen is typical of the manner in which the pattern features

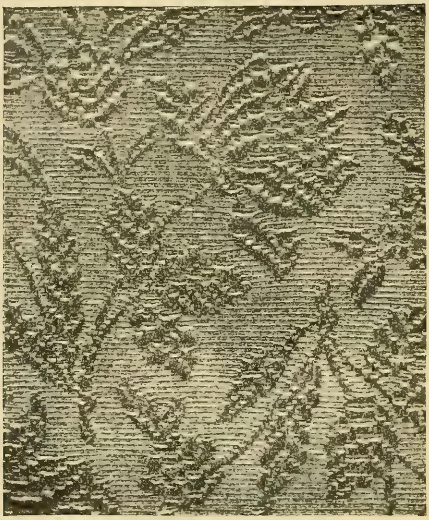


Fig. 302.—Warp Matelassé—Ribbed Ground.

are produced in clear floats of warp, with the ground formed in fast repp or cord. It will be observed on referring to the sectional plan—Fig. 302a—that the design results from the use of two series of warp yarns *g* and *f*—ground and figuring—and of three series of picks, g', b, and b'. The picks marked in ☒'s, are only inserted into matelassé fabrics in which weft as well as warp figuring is developed. For the ground repp, the threads *f* are depressed on every third pick, but, for the warp figuring, they float over picks g' and b. In such figured

portions of the pattern, the ground ends *g* interlace plain on picks *b*. The practice in weaving in plans so constructed is—

1 pick of fine cotton foundation.
1 ,, ,, silk for supplementary weft figuring, or the effects marked in ☒'s ; and
1 ,, ,, binding.

With the warp arranged—

1 thread of two-fold cotton ; and
2 threads of organzine silk, drawn one end in a mail.

On picks *g′* the cotton warp threads (healded on shafts in front of the harness) are depressed, and the silk warp threads lifted. On picks *b*—extra figuring weft yarn—all the silk and

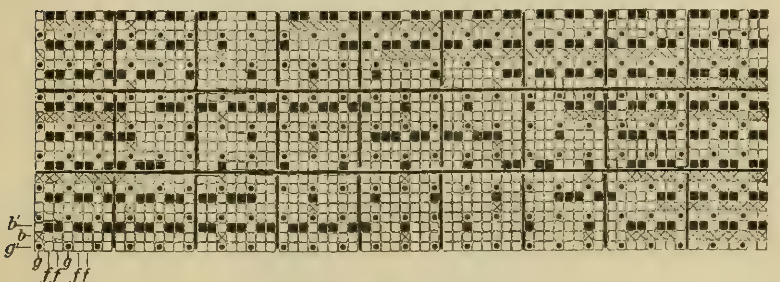


FIG. 302A.

cotton threads are lifted in all parts of the design, excepting where these shots are used in decorating the surface of the fabric and where they are stitched on the back ; and on picks *b′*, the silk threads are depressed in the repp ground, but lifted in the figured portions, where they stitch plain with the cotton warp. This principle of designing, without the extra weft yarn, is shown in Figs. 303 and 303A. The method of looming for this example is—

1 thread figuring ;
1 ,, ground ; and
1 ,, figuring.

The form of the effect in the texture is traceable in the looming plan, which is a compound of small repp and of broader cord effects. The foundation threads are again

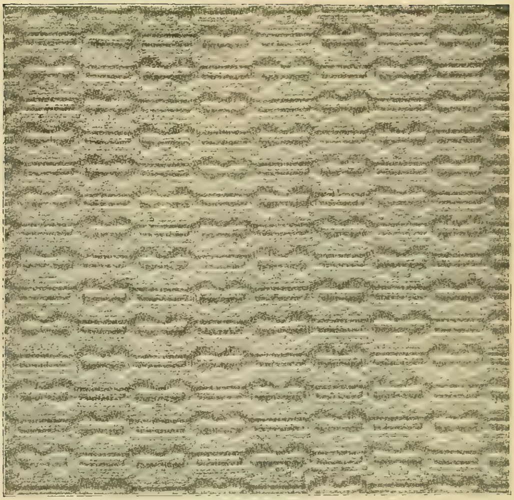


FIG. 303.
FANCY WARP MATELASSÉ CORD.

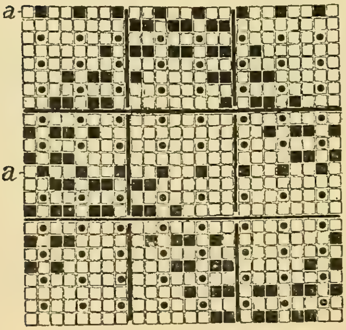


FIG. 303A.

marked in ⊡'s, and the figuring or repp threads in ■'s, the specimen having been woven thus—

Warp.

1 thread of 60's two-fold silk.
1 „ „ 2/60's cotton.
1 „ „ 60's two-fold silk.
20's reed 6's.

Weft.

11 picks of 2/60's cotton.
1 pick of 10's cotton (4 threads counted as 1).
96 picks per inch.

The picks *a* are wadding, or those on which the silk warp threads are lifted and the cotton warp threads depressed.

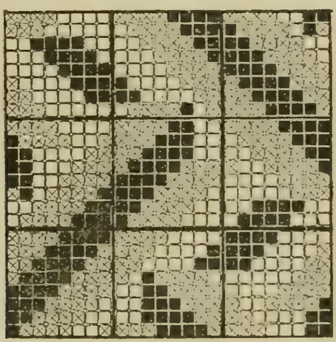


FIG. 304.

The technique of this fabric build and of this style of pattern is further illustrated in Figs. 304 and 304A, one the effects as outlined on point paper, and the other the actual plan of the texture, as produced in the loom ; with, however, the sections lettered *a* in Fig. 304A corresponding to those in ⊠'s, in Fig. 304.

The sections marked in ■'s would, in the fabric, be floats of weft, those lettered *a* solid floats of warp, and those marked in ⊠'s, ottoman rib. How these several effects are acquired is apparent on a closer analysis of the design. For example, the ground or repp effect is due to the odd picks depressing the face warp, and to the even picks floating under the face

warp in such sections of the pattern as the repp is formed. This implies that the face warp is down and up alternately, every thread working alike in all the unfigured parts of the fabric, an arrangement insufficient to make a warp rib or cord. The ground or foundation warp threads, by interlacing one up and one down, or just the reverse of the face warp,

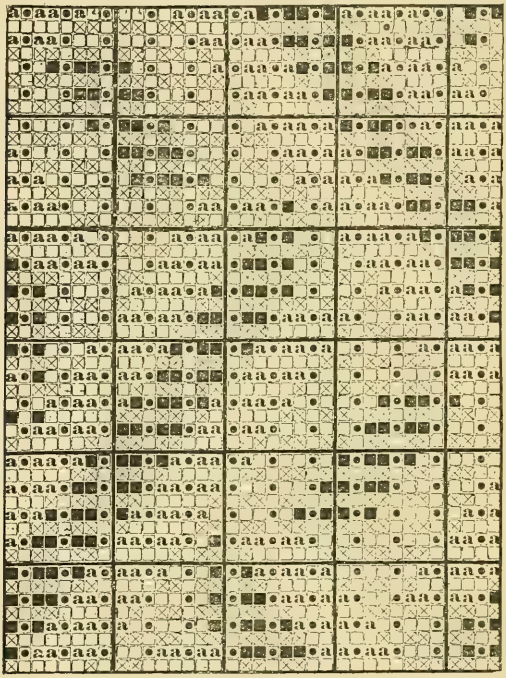


FIG. 304A.

are necessary to develop the repp characteristic. To make an ottoman repp or soliel, two warps are required, the face warp being closer set then the backing warp, and not so well tensioned as the latter. In weaving, the face warp is lifted and the ground warp depressed, and a thick pick introduced into the shed thus framed. Next, the ground warp is lifted, and the face warp depressed, and a small-yarn pick interwoven. These are the weaving conditions in Fig. 304A, and also in Figs.

302A and 303A, when the repp features are being produced. The weft figuring on this repp ground is acquired by floating the face weft over a certain number of figuring warp threads, and also by flushing over the same group of threads the ground weft. To get the figuring in warp, the face yarns are allowed to float over both the ground and figuring picks.

When various weave effects are required in the development of the figuring, they are shown on the looming plan, as in the sectional design, Fig. 305. Here the ground of the texture would be in repp, portions of the figuring in warp twill, and portions in a broken twill, showing that decorative patterns are weavable in different weave units, and with the surface effects in a raised quality as in Figs. 302 and 303. This example is drawn to the scale on the point paper of the fabric setting, or of 3 ends of warp to 1 pick of weft in the loom.

273. *Shading Practice in Figuring.*—Ordinarily, the reproduction on a textural surface of decorative forms in light and shade does not result in fitting styles of ornamentation. It is essential that, in originating figured effects in textiles, the fabric should be alike level in structure and in appearance. With the designs composed of shaded objects, the figuring is observed to be more or less detached from the ground of the texture. Sectional parts of the decoration are in shaded tones and others in relief, whereas all parts should be visually and actually in the same plane.

Every variety of line and feature, in naturalistic or in geometric forms, may, however, be faithfully depicted in a textural product, either in monochrome or in colour. The principles of warp and weft interlacing, and of coloured-thread and coloured-shot insertion in weaving, admit of realism in design expression. The delineation of decorative elements in light and shade is, therefore, feasible on woven as on other surfaces—porcelain, paper, etc. When shading is, however, practised in textiles, it is rather with a view of expressing pattern details clearly and effectively than with a view of an exact imitation of floral, plant, and other forms.

It follows that, without tone contrasts, a description of shaded patternwork is possible in the loom. Thus, in developing shaded ornamental types, gradations in warp and weft

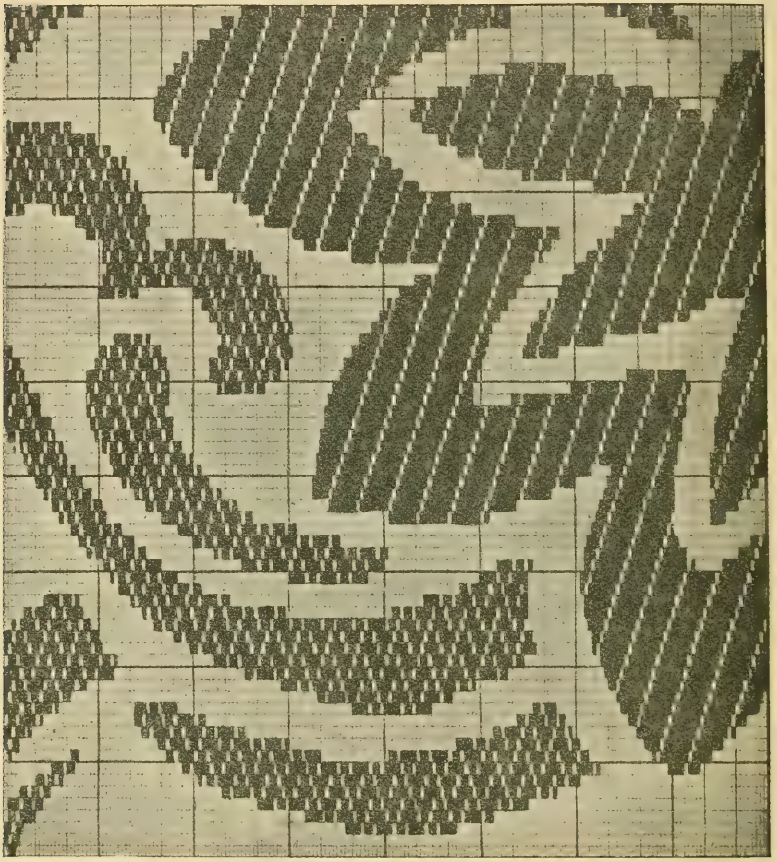


FIG. 305.—FINE-SET MATELASSÉ PATTERN. (*Section only.*)

intersections correspond to gradations in dark and light tones. The ordered or symmetrical grouping of these—as in sateen weaves, Fig. 90—correspond, in textural definition, to the results obtained by stipling, painting, and printing on a smooth, plain material. The shaded portions of the style

in Fig. 286 are not due to any difference in colour tone, but to a difference in the degree in which the weave units employed bring the warp or weft features on to the face of the fabric, The deeper tones are formed in weaves of a weft-face structure, with intermediate degrees of tinting or toning composed of intermediate types of weave.

274. *Scale of Intersections.*—As between the dark tone and the light tint of a colour, intermediate tones and tints are producible, providing the "scale of shades" in such a colour unit, so in weaves between the extreme *warp-face* and the extreme *weft-face* effect, as in sateens, twills, diamonds, etc., a "scale of gradations" in intersection types is obtainable. This is shown in the shaded diagonal in Fig. 90, in which the weaves run from a *warp* effect—giving a light tone in the texture—to a *weft* effect, producing a deeper tone in the texture or *vice versa.* With the weft intersections printed in black, and the warp intersections in white, the shading due to the changes in the weaves *a*, *b*, *c*, and *d*—all constructed on the same sateen base—is clearly observed. The softness and full graded quality of the toning vary with the dimensions of the weave base. The 8-shaft sateen allows of seven degrees of toning, the 10-shaft of nine, and so on. A tone degree is equivalent to a warp or weft intersection, hence the gradations or shading in the design is prescribed by the weave units selected.

The use of other weaves than sateens and twills in developing shaded tones in one colour is illustrated in Figs. 286 and 306. In the design in Fig. 286, the shading is produced in weaves of a twilled mat character, but in the rectangular sections of the style in Fig. 306 it is developed in a diamond type of crossing. The diamond weave in the upper portions of the figuring has a maximum weft float, covering fifteen threads of warp, and in the lower portions a minimum float of three. The tinted gradation is obtained by increasing the repp interlacings surrounding the diamond elements, in which respect the practice differs from that of acquiring textural tone in

warp and weft-face weaves by modifying the system of intersection. As a principle of "weave" shading it is adapted to light textures, and also to compound fabrics in which the yarns, when floating on the face to form the extreme weft effects, are bound regularly into the central part of the structure.

Weave shading is harsher in tone in the coarser, and softer in tone in the finer, set fabrics. The intersection tones are also modified by the depth of contrast between the shade or colour of the warp and weft yarns, but it should be clearly understood that colour contrast is not an essential part of the shaded patterns in textiles as in other decorative ornament. Obviously, in pure white yarns, or in yarns of exactly the same colour in the warp and weft of the design, weaves symmetrically varied in the order in which they give a *warp* and *weft* effect develop a toned textural surface. Shading in woven design may, therefore, be analysed either as distinct from, or as associated with, tone modification as a product of light and shade. It constitutes a scheme and practice in weaving which enables decorative effects to be accurately formed minus contrasts due to colour tinting and toning.

275. *Looming Structure—Shaded Designs.*—In the work of transferring the sketch on to point paper of designs in which the figuring is executed in light and shade, the weave units are accordingly combined to agree with each gradation in tone. The dark tones in the drawing are equivalent to weaves of the maximum weft intersections, and those in light tones to weaves of the maximum warp intersections (or conversely), with the intermediate tones in the sketch corresponding with the intermediate weave structures.

This method of work is practised in preparing all varieties of shaded patterns for the loom, and is observed in the transference of the different effects on to point paper in Figs. 307, 308, and 308A. Thus taking Fig. 307, the small, conventional, floral forms comprised, are, first, clearly defined and distinguished from each other in weave composition; second, the

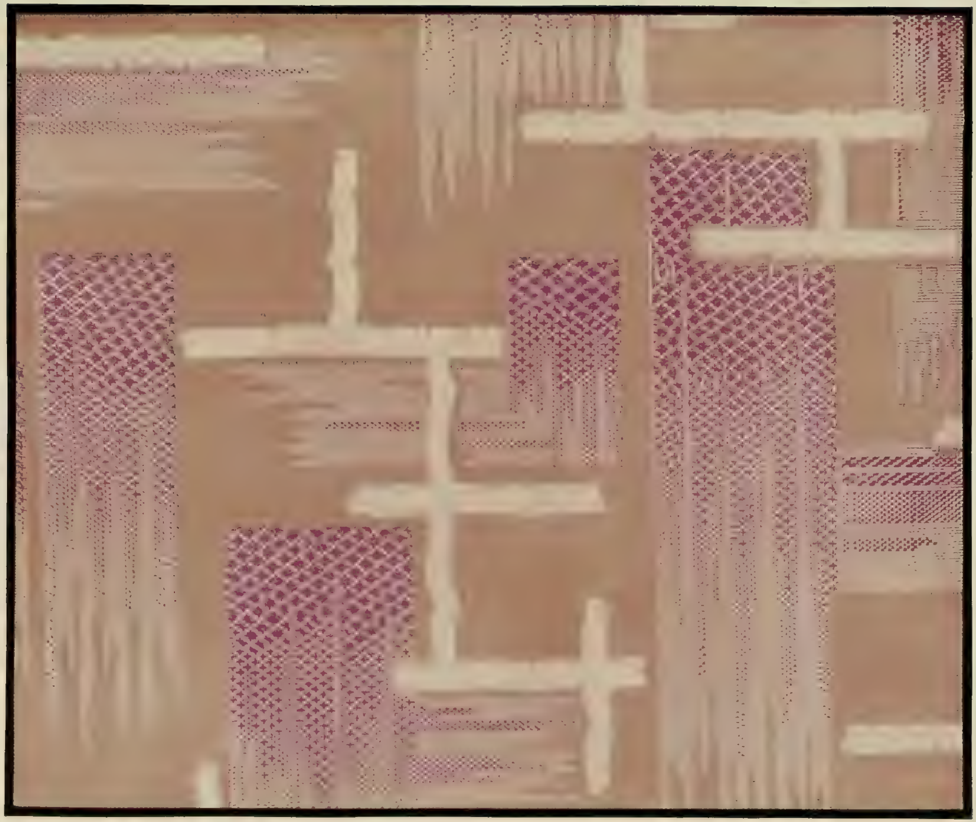


Fig. 306.

Silk Specimen Shading in Diamond-Weave Structures.

darker tones are developed in sateen; third, the outlines of the flowers are produced in weft floats; fourth, the structural termini of the leaflets are formed in twilled lines; and lastly, the shadows and veins on the leaves are expressed in warp

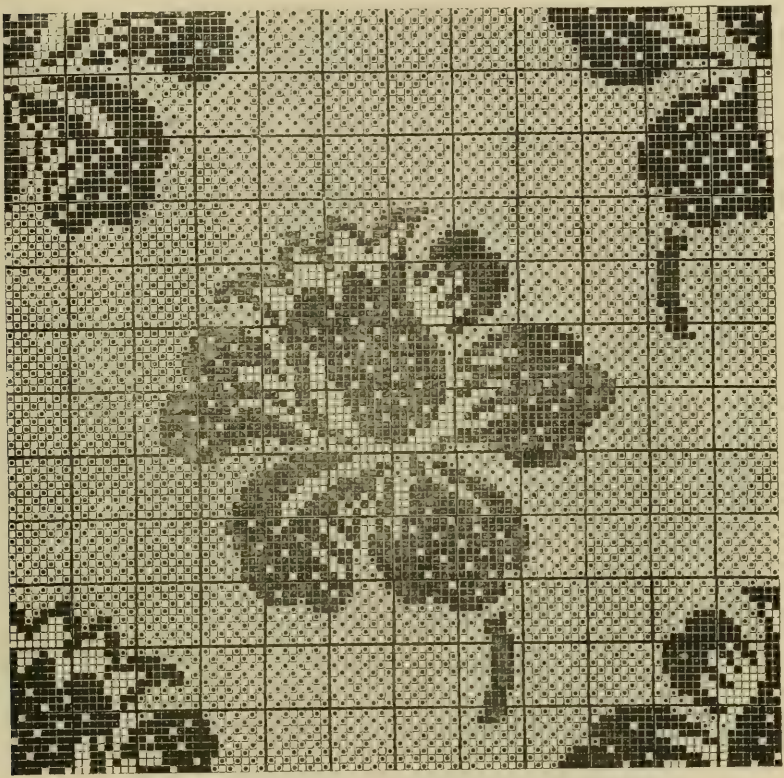


FIG. 307.—ELEMENTARY TYPE OF SHADED PATTERN.

floats and reversed twills. The correct transference of the sunflower type—sectional part of the design shown in Fig. 308—on to point paper imposes the selection and use of a larger assortment of weave units. It comprises extreme light and extreme dark tones. The primary feature to determine is how to acquire these two effects. Taking the 8-end weft sateen to represent the former, and the 8-end warp sateen to

represent the latter, a basis of work is established. Having correctly sketched the decorative forms on point paper and to scale, the outlines are developed in weft lines in perfect conformity with their structure. The more solid or darker

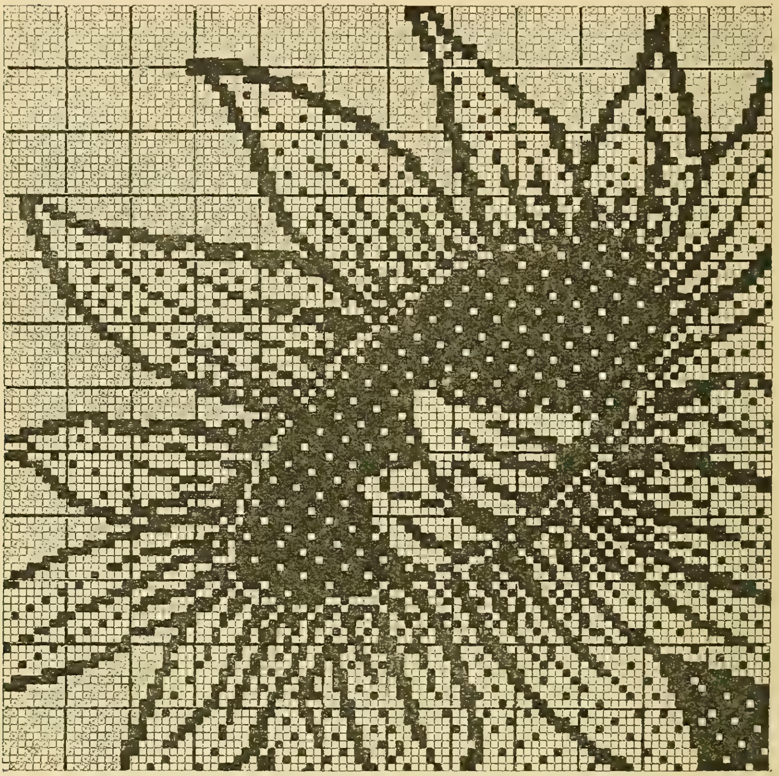


FIG. 308.—SECTION OF SHADED FLORAL DESIGN.

sections are next treated, as, for example, the central portion of the flower, and the stronger lines in the petals. Then follows the definition of the fine and slender details in correct schemes of intertexture.

In the third illustration—Fig. 308A—(one figure of a butterfly pattern, with eight figures in a repeat each differently depicted, and weavable in silk warp and weft yarns) the shading of

the extremities of the wings is developed in weft sateen. The same weave is employed in forming the head, body, and feelers of the butterfly. The half-tones in the wings are expressed in common twill, in which the dark and light colours

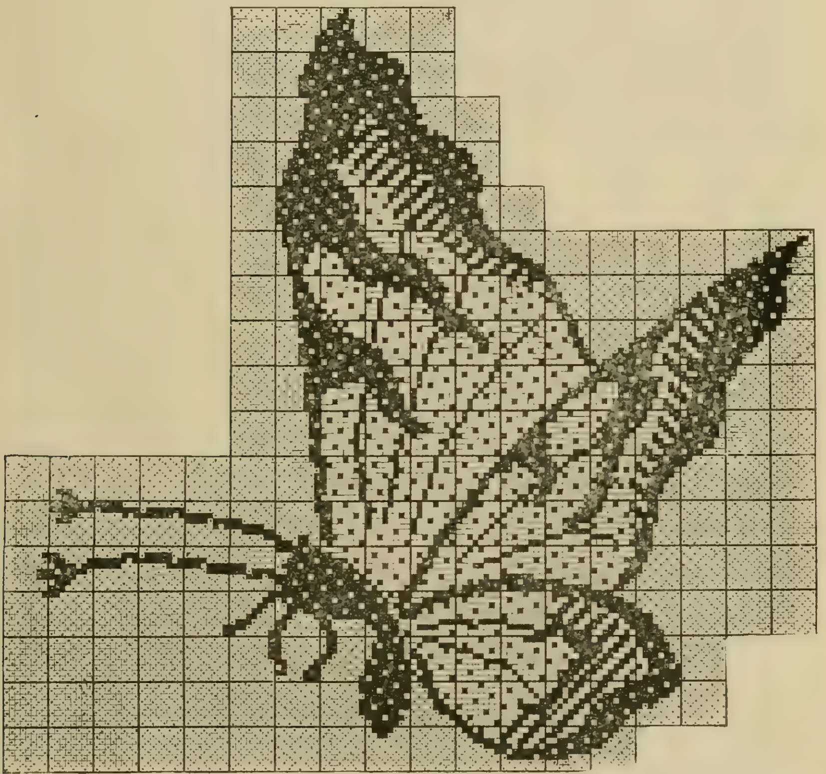


FIG. 308A.—SECTION OF BUTTERFLY PATTERN.

applied in the warp and weft would be equally commingled. For developing these tones in keeping with the delicate markings on the wings, the twilled lines are run in two directions, and joined up with, or mellowed into, the other weave ingredients in the design. The still more delicate lines in the figure are formed in small weft interlacings, again fitting with the warp sateen, which gives the smooth, soft texture of the

wings, and allows of these being distinguished from each other in special weave units.

While the original sketches for shaded textiles may faithfully represent, in tinting and toning, natural and other forms, for looming purposes the composition of the sketches is simplified. The elemental features are preserved and strengthened, but unnecessary lines and tones are eliminated, leaving the patterns structurally adapted for reproduction in a woven fabric.

CHAPTER X

PILE, LAPPET AND GAUZE STRUCTURES

276. *The Characteristics of Pile Manufactures.*—In the dress trade, pile-woven goods comprise velvet, *frisé*, velveteen, corduroy, lambskin, and light plush fabrics; and also a variety of fancy and figured textures in which portions of the surface are plain, twill, or sateen, and other portions formed in velvet, looped, or feathery features. A pile fabric is one in which the ground warp and weft yarns are covered with either a fibrous fur or shag, or with buckled, coiled, looped threads. The former may, as in the velvet, project in vertical line from the structural foundation, or it may be laid, as in certain long filament plushes, on the face of the cloth. The latter type of pile may consist of compacted series of bended or looped threads as in terry and *frisé* manufactures, or it may consist, as in woven astrakhans and lambskins, of curled-yarn

effects. Each variety of pile conceals the ground yarns employed in weaving. Velvet and velveteen—in which the pile may closely resemble the fur of the beaver—are illustrative of the cut-pile principle, and curls and *frisés* of the looped pile principle of intertexture.

The length of the pile is varied with the quality and application of the manufactures. In both the silk and cotton velvet, the pile is of the shortest and closest character. In plushes the pile is longer and less dense, and in curls the pile differs, in closeness of structure and also in measurement, with the thickness or counts of the specially-prepared yarns in which it is developed.

Quality in woven fur is necessarily determined by correctness of manufacture, but, in a particular sense, in velvets, velveteens and corded velvets, by the fineness, density, and length of the fibres of which the pile is composed. Inferior classes of texture may be finished to present the gloss and smoothness of a fabric of a better construction. This is feasible because a velvet pile, comparatively loose in formation and consisting of longer filament than that of a thick-set pile, develops, when laid in the dressing process, a high degree of lustre and softness. Thus, the length of filament in velvet and velveteens may be made to impart visible, but not actual wearing value. Density of pile, combined with fineness of fibre, are the features which produce the most satisfactory grade of these textiles.

277. *Two Systems of Pile Looming and Weaving.*—Pile goods are acquired on two systems of fabric construction and manufacture known as the *warp* and as the *weft* schemes of looming and weaving. Velvets and looped plushes are examples of the first, and velveteens and ribbed velveteens of the second practice. The *warp-pile* textures are two or multi-ply in the *warp*, and the *weft-pile* textures two or multi-ply in the *weft*. To produce the *warp-pile*, one series of threads is interwoven with the weft to give the ground of the cloth, with a supplementary series

of warp ends passing over wires, automatically inserted into and automatically withdrawn from the sheds in the warp during weaving. To produce a *weft-pile*, one series of picks forms, with the warp ends, the ground cloth, and the supplementary series floats loosely but regularly on the surface, the floats of the weft yarn thus formed being severed after the piece is woven.

278. *Velveteens.*—Cotton velvets form the more elementary type of weft-pile fabrics. The principles of their manufacture will be understood from the weave structures at A, B, C, D, E, and F, Fig. 309, in each of which the picks marked in ⊠'s make the foundation cloth, and those marked in ■'s the pile or plush. It will be observed that the latter interlace plain or in simple twilled order. The object of this is to provide "thread races" for cutting, enabling a perfect pile, or one closely resembling the pile got by the uses of wires, to be developed. This arrangement of the warp threads in the weave also reduces the "races" to a minimum number in any build of weft-pile texture. The "race" positions in the plans are indicated by the arrows. Fig. 309A is the weave employed in the production of the lighter makes of velveteens. It is arranged one pick of ground and two picks of floating yarn, and only allows of this yarn passing over three successive warp threads. In plans B and C, the order of shuttling is one pick ground and three picks pile, with the pile picks floating over five threads, and with a plain ground in B and a fine twilled ground in C. A fuller and longer pile is obtainable by the use of weaves D and E, again plain and twilled in the ground, but with the pile shots in D covering seven threads, and in E nine threads. The double binding of the picks in the latter, as seen at the points in ■'s and in ⊡'s, has the effect of making a fast pile, or one securely stitched into the ground. Another method of construction applied in producing the heavier descriptions of fabric, and in which mohair or cotton yarn is applicable in the pile weft, is that given at plan F. The pile picks cover nine threads, and are stitched in 5-end sateen

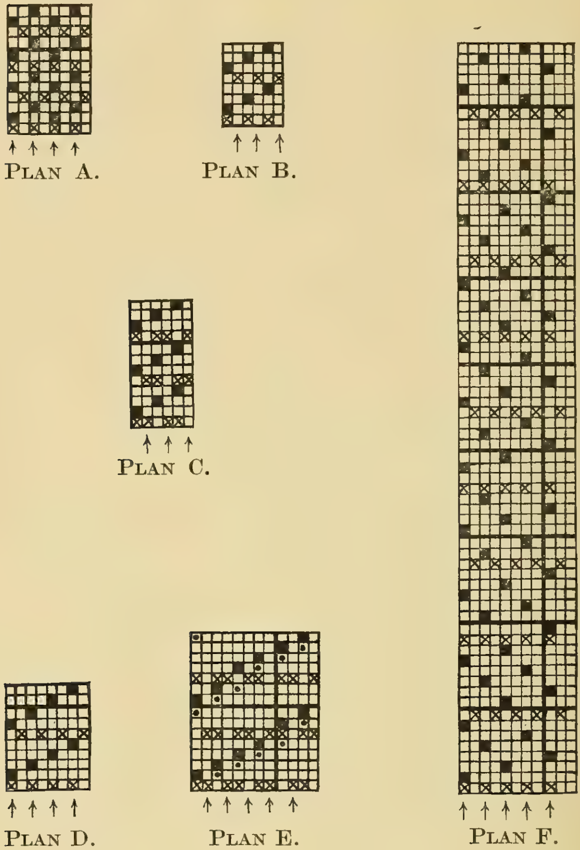


FIG. 309, A TO F (*Marks = Weft*)—VELVETEEN PLANS.

order, with six picks of pile to each shot of ground weft, suitable looming particulars for this example being—

(1) *Warp:* 2/30's cotton, 32's reed 2's,
Weft: 30's cotton,
500 to 540 picks per inch.

(2) *Warp:* 2/34's cotton,
Weft: 20's mohair,
72 threads and 250 to 300 picks per inch.

Velveteen-pile goods are heavy wefted cloths, and require the warp yarn to be of a good strong quality, and the warp

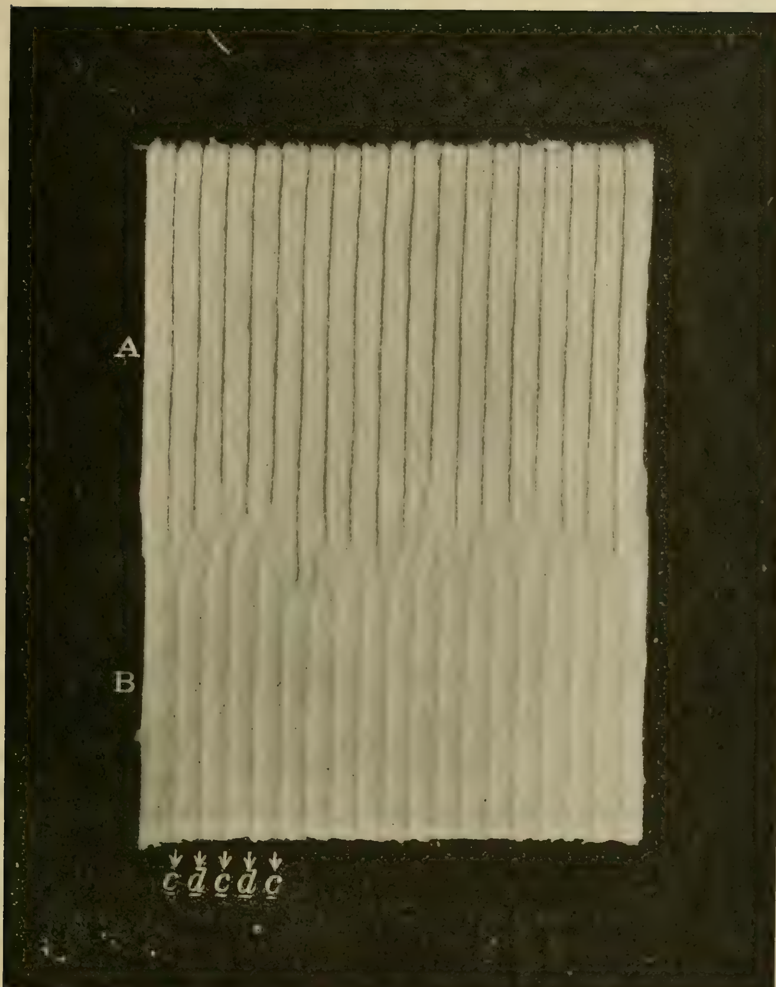
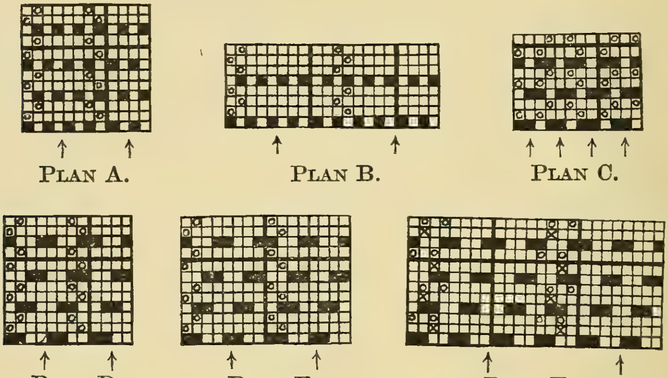


FIG. 310.—SPECIMENS OF "CUT" AND "UNCUT" VELVETEEN CORDS.

shedding to be accurate and true. Positive tappet looms (Woodcroft or Beaumont and Hill principles) are employed. As they are weft-face fabrics, they are not difficult to shed, but the warp is well tensioned to admit of the pile picks being forced into the closest possible relation with each other.

279. *Ribbed Velveteens.*—In weaving ribbed velveteens or corduroys, the scheme of construction, like that in velveteen, results in a firm ground cloth—plain or twill woven—on the upper side of which the pile yarns are floated in bands or stripes lengthways of the textures. The appearance of the



PLAN A. PLAN B. PLAN C.

PLAN D. PLAN E. PLAN F.

FIG. 311, A TO F (*Marks* = *Weft*)—CORDED VELVETEEN PLANS.

cloth in the loom, and also when cut, is shown at A and B in the specimen in Fig. 310. The pile picks produce tunnels of surface yarn between the binding points *c* and *d*, which are more clearly defined in the "cut" than in the "uncut" sections of the sample. These surface layers of yarn vary in compactness and in width with the make and style of the cloth produced. The system of weave construction will be evident on examining plans A, B, C, D, E, and F, Fig. 311. The ordinary type, with a plain foundation, is shown in weaves A and B, giving cords or stripes of four and eight threads, respectively, and woven one pick of ground to two picks of pile in A, and three picks of pile to one of ground in B.

The "thick-set" variety of cloth is shown at C, Fig. 312, for which the plan is shown at C, Fig. 311. In this weave the picks marked in ⊡'s pass over one and three threads. The standard fustian cord—specimen A, Fig. 312—is obtained in plan D, Fig. 311, and in such weaving particulars as 2/24's cotton warp, 34 ends and 200–400 picks of 20's weft per inch, varying with the weight of cloth required. Genoa cords—specimen B, Fig. 312—are woven in the weave illustrated at plan 311E, with the picks floating over six and eight threads, and the fabrics manufactured in similar yarns and setting as the fustian cord. "Constitution" cords are broader ribbed velveteens, made in plans arranged as at 311F, in which the pile picks, marked in ⊠'s, are singly stitched, and those marked in ⊡'s double-stitched. Spotted and simple-figured cords are also produced by reversing the positions of the two series of picks or of the ground and floating weft yarns; so that where the spotted features are developed, the pile picks are taken on to the back of the fabric, while the structure, formed by the ground warp and weft, is brought on to the face.

280. *Weft Plushes and Curls.*—On the weft-pile principle of intertexture, plushes, with a straight or vertical pile, or curls of the astrakhan varieties, are weavable. The pile is neither so closely made nor woven in such fine counts of yarn as in cotton velvets and cords. Mohair and similar sorts of yarn take the place of the cotton pile weft, and woollen as well as cotton is employed in forming the ground of the cloth. For fabrics in which the ground is cotton and the plush mohair, the weave structures are arranged as in plan A, Fig. 313. The pile picks are grouped two-and-one with the foundation picks and interlace in sateen order, the 5-end make having been extended in the threads, and so planned as to allow of these shots being twice stitched, and of their floats covering seventeen threads. The "race" positions for cutting are shown at the foot of the plan.

Other methods of construction are illustrated in Figs. 313B

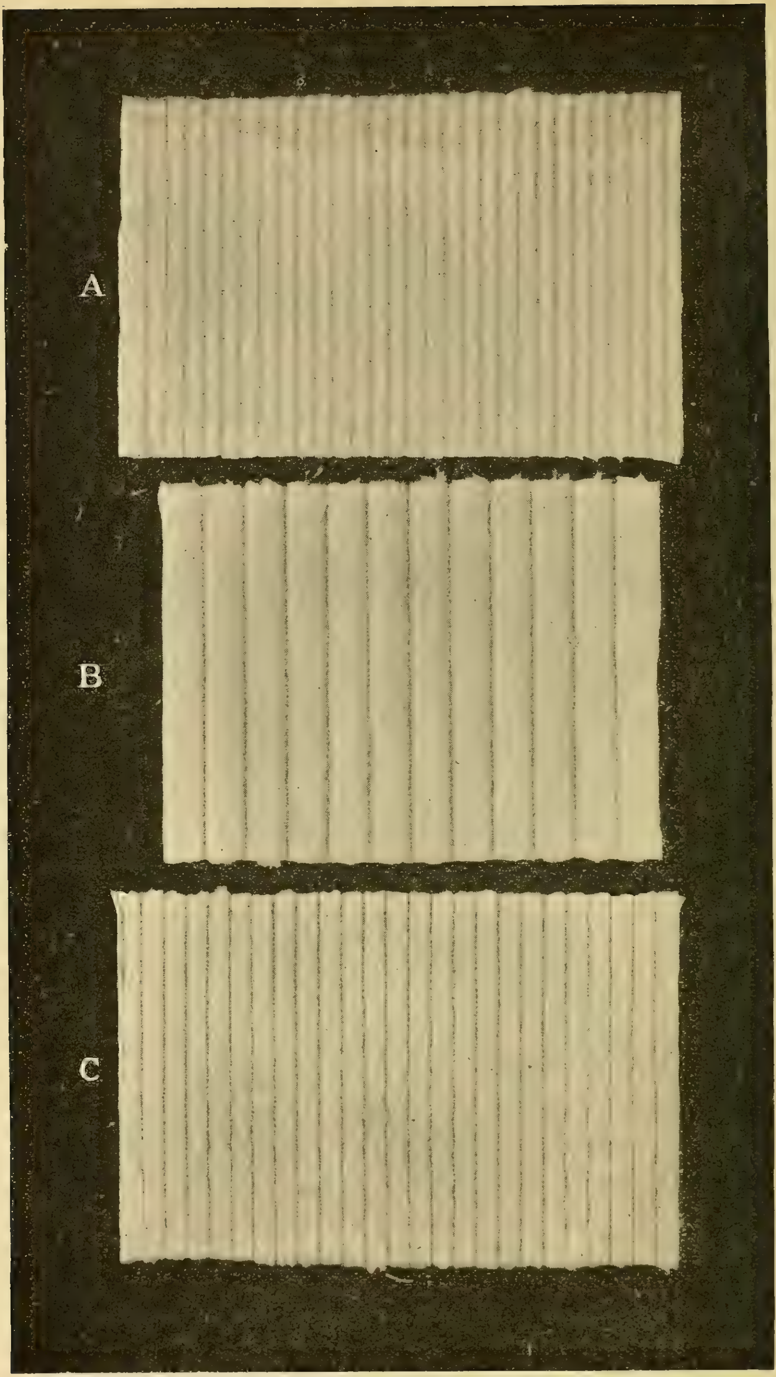
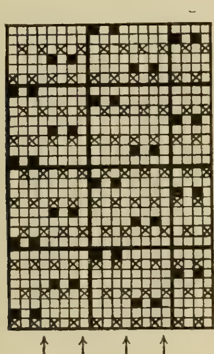


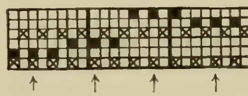
FIG. 312.—"FUSTIAN," "GENOA" AND "THICK-SET" CORDS.

and C, the first producing one length and the second two lengths of plush. The picks marked in ■'s, in plan C, float over nineteen threads, and those marked in ⊡'s over twenty-three threads. Such plans are usable in making curled goods of either a light or medium weight. The curl characteristic is acquired by employing mohair yarn, which, prior to winding for weaving, is wrapped on broaches, and either steamed or boiled for two or more hours.

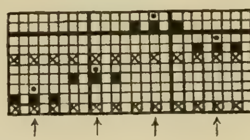
The pieces in the loom have a level surface, but on the pile picks being cut in the places indicated on the designs, they



PLAN A.



PLAN B.



PLAN C.

FIG. 313, A TO C.—PLANS FOR WEFT-PLUSH OR WEFT-CURL FABRICS.

buckle, curl, or loop. Assuming, for illustration, the warp to be 2/30's cotton and the weft, for plan B, one pick of 18 skeins wool and two picks of several-ply mohair yarn, and for plan C, Fig. 313—

1	pick	of	woollen,		
1	,,	,,	mohair	shade	(1)
1	,,	,,	,,	,,	(2)
1	,,	,,	,,	,,	(1)
1	,,	,,	,,	,,	(2)

the ground of the textures would be plain-woven—cotton and woollen—and the curl features would be developed in mohair yarn. The number of picks per inch depends on the quality

and fulness of pile required; but, in all cases, a firm, fast ground cloth is essential. To ensure this with, say, 32 ends per inch in the warp, there should be a similar number of ground picks, giving in plan 313B, 96 picks, and in plan 313C, 160 picks per inch. The frequency with which the ground shots are inserted binds the pile (which, when cut, would, in a loose texture, be liable to draw out) securely to the cloth. This method of weft setting is applied in producing the straight plush, when the shots per inch must be in keeping with the density of pile desired. In curls, however, the picks per inch are reducible, as portions of the ground of the fabric may be visible or only partially covered with pile yarn, and for this effect thick yarn is used in the pile, with the picks per inch proportionately decreased. Should, for instance, the curls be of the larger variety and formed in a thick yarn, or should they be thinly distributed on the surface and formed in long floats, the woollen yarn used for the ground may be made to develop a special feature on the face of the fabric.

281. *Semi-Curl Effects.*—The use of curled mohair or lustre yarns, admixed with cotton worsted and woollen yarns, results in looped and buckled effects being obtained in the woven manufacture. Even providing the mohair is used as spun, cockled and semi-curled textural details are producible. Thus, in Fig. 298—Paragraph 269—these details are shown to be due to the inequalities in shrinkage value of the worsted and mohair threads of which the cloth is made. One of the textures of this compound cloth consists of the former, and the other texture of the latter yarns, the two textures interchanging from the face to the back position in the production of the design. It was pointed out that, in the scouring treatment the worsted texture contracts evenly, and the mohair texture more expeditiously but unevenly, so that in the process the mohair is drawn into a napped or cockled structure.

Curliness in single-make fabrics—non-plush woven—is obtainable by selecting prepared or unprepared mohair yarns and using these in the weft, with Botany worsted yarns in the

warp. The designs are constructed on the weft principle of figuring, with a warp-face weave in the ground for giving a level cloth, and also one in which the intersections of the weft are barely traceable. In the specimen given of this kind of imitation plush in Fig. 314, the warp yarns are 2/60's worsted, the weft yarns 2/32's mohair, and the ground weave $\frac{3}{1}$ twill. The pattern is woven in floated weft yarn, the flushes varying from three to twelve threads in length. With the floats grouped in regular compact order and covering a fair proportion of warp threads, they give the raised, waved effects, R. When the floats are arranged irregularly and in spotted and detached sections, they produce a species of minute curl, C. The difference, however, between this quality of looped textural surface and that acquired in weaves of a special structure, A, B, and C, Fig. 313—is quite marked. There is strictly, in the ordinary compound make of cloth—Fig. 314—no evenly developed curliness. The mohair weft yarns remain uncut in the piece, or, as shuttled, whereas, in weft plushes, the floats are severed, so that the free ends and the picks form into curls of a definite size and frequency on the surface of the fabric.

282. *Spotting in Weft Plushes.*—For spotted and mottled patterns in weft plushes—either in straight or curled pile—the pile shots are alternately floated on the face and regularly bound into the make of the cloth. The specimen of "straight," "spread," or "cut," pile texture in Fig. 315, is produced in 2/24's cotton, and wefted two picks of cotton, one pick of woollen, and one pick of thick mohair. The picks of the design—Fig. 315A—printed in ⊠'s are cotton, those in ⊡'s woollen, and those in ■'s in mohair yarn. The woollen picks give a weft-face effect, and are intended to be in a bright colour to tint the groundwork of the plush, and also to conceal the cotton warp and weft. The pile spottings are planned on the 6-end sateen base, the shots marked in ■'s representing the black mohair picks in the specimen, and the shots marked in ⊡'s the white mohair plush yarn. Both yarns float equally,

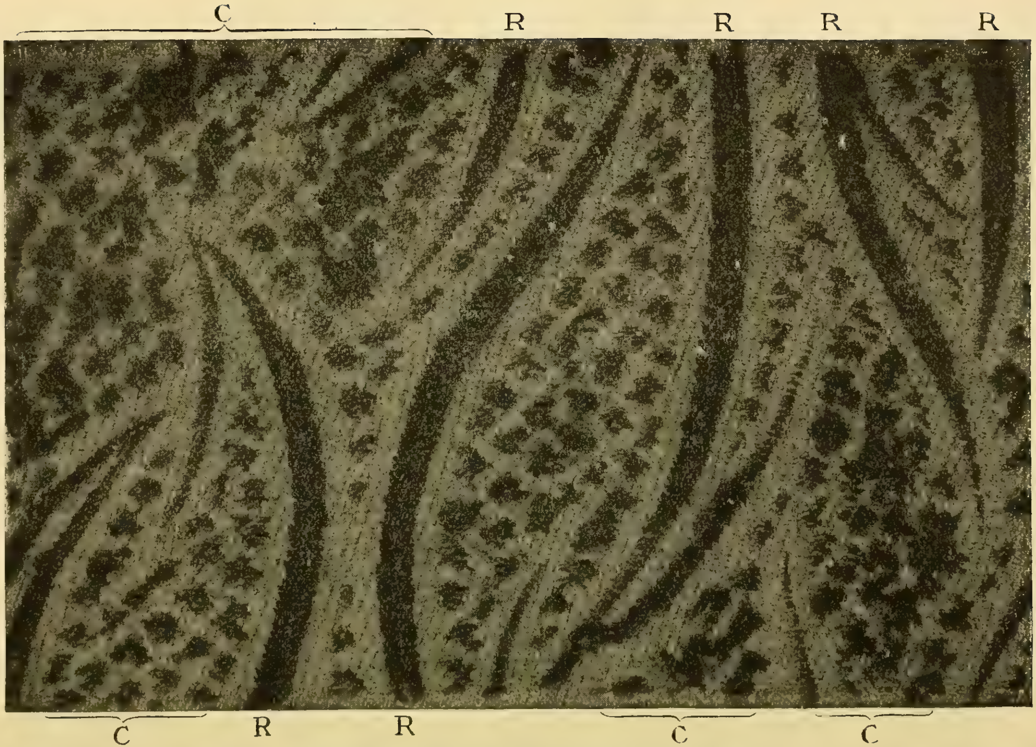


Fig. 314.—Semi-curl Figured Cloth.

or over thirty-one ground threads. This length of flush yields a good depth of pile. Surface brushing, when the piece is in a steamed condition, has the effect of straightening and laying the tufts of fibres of which the pile consists in this class of manufacture.

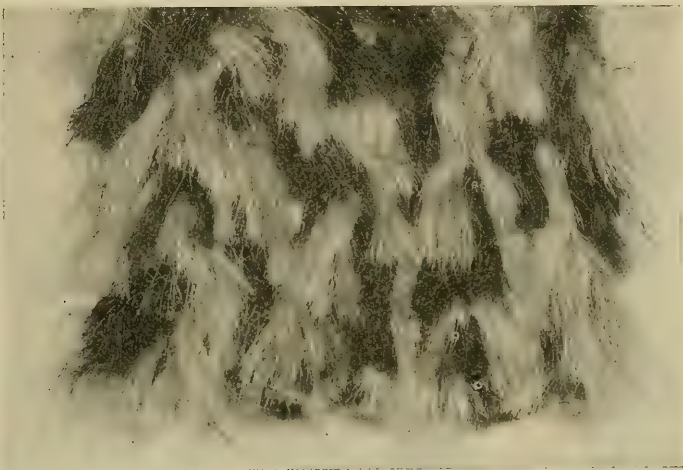


FIG. 315.—WEFT PLUSH—TWO-COLOUR STYLE.

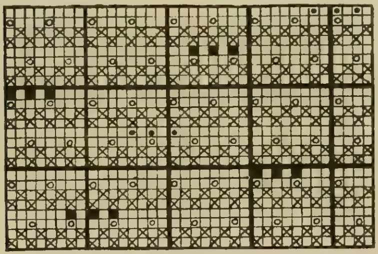


FIG. 315A.—WEAVE FOR FIG. 315.

283. *Curl Spotting-Lambskins.*—In spotting in two or several colours in light curl textures of the lambskin character, the designs are constructed as seen in Figs. 316 and 317. These are the reduced or looming plans. The complete healding draft—Fig. 316A—is supplied for the first plan, and a section

of the healding draft—Fig. 317A—for the second plan. The two plans differ in structural arrangement. Fig. 316 is woven two picks of ground yarn and one pick of curled or flush yarn, and Fig. 317 two picks of ground yarn, one pick of small flush yarn—double six-end sateen, printed in ⊡'s—and one pick of thick curl yarn, printed in ■'s. Opening out the two weaves in accordance with the healding drafts, would show that the ground picks interlace plain, and that the single intersections on the curl picks in Fig. 316 are equal, in the texture, to three and the double intersections to six stitching points; while, in Fig. 317, the double intersections are equal to four and the treble intersections to six binding points in the cloth. When the plans are thus extended, the longer flushes in Fig. 316 cover forty-three, and the

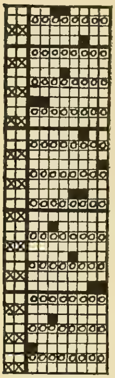


FIG. 316.

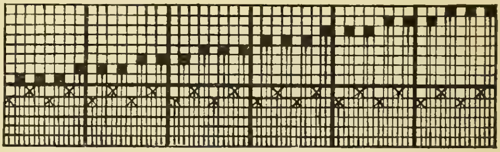


FIG. 316A.

WEAVE AND DRAFT—CURL AND LAMBSKIN TEXTURES.

shorter flushes thirty-seven threads; and, in Fig. 317, the longer flushes cover forty-three and the shorter flushes twenty-one threads.

The designs are producible in such weaving data as given below—

FIG. 316

Warp: 2/30's cotton
24's reed 2's.
Weft: 2 picks of 2/30's cotton
1 pick of 8's worsted
2 picks of 2/30's cotton
1 pick of 8's worsted.
2 picks of 2/30's cotton.
1 pick of 6's mohair (six threads as one)
84 picks per inch.

FIG. 317

Warp: 2/24's cotton
22's reed 2's.
Weft: 2 picks of 10's cotton
1 pick of 12's worsted or 24 skeins woollen
1 pick of 6's mohair (six threads as one)
96 picks per inch.

It will be noted that lambskins and loose-set curl textures of this character are not wefted on the principle followed in producing a full, close plush. It is not the object in these manufactures to make a close, dense pile but to spot the surface of the fabric with bright curls at intervals. The mohair yarns are used for spotting and the worsted or woollen yarns for developing the napp or curl filament effects. Hence the two yarns in the

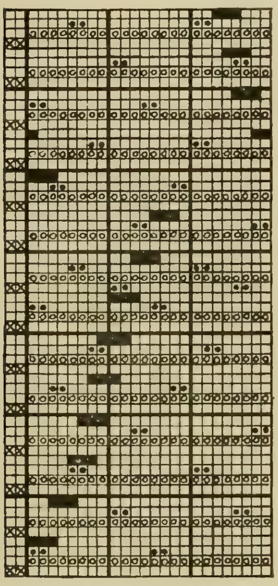


FIG. 317.

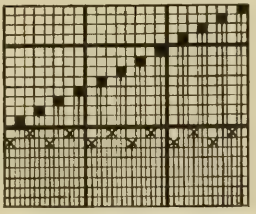


FIG. 317A.

WEAVE AND DRAFT—CURL AND LAMBSKIN TEXTURES.

designs are flushed differently. With the idea of obtaining a close ground napp in Fig. 316, the worsted yarns float to the greater degree, concealing the plain cotton structure, and making a pile of fibre on which the lustrous yarn is formed into distinct curls. On the other hand, in Fig. 317, the lustrous yarn floats to the greater degree, and the worsted yarn is employed for giving a full, short napp in the ground. The curls in this example are developed in inverted twilled lines or in simple details transposed.

These fabrics, and the many varieties of woven lambskins of which they are typical, are made in light and delicate shades, frequently white or cream in the ground. Coloured mohair yarns, especially in light tints, are also used for spotting, but while they result in diversity of textural style, they somewhat detract from the lambskin quality of the cloths.

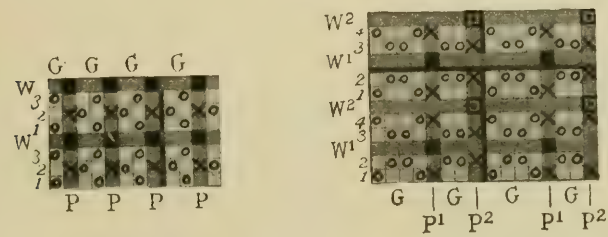
284. *Warp-Pile Principle—Velvet and Terry.*—As explained, in all classes of *weft-pile* goods the plush is formed by floating certain picks in the weave structure on the right side of a firm-woven cloth. By cutting the floats of these picks in the thread "races" longitudinally, and after the pieces leave the loom, the pile quality and character are obtained. In all classes of *warp-pile* goods the plush is formed in the warp and in the actual process of fabric production. The special warp yarns, used for this purpose, do not float loosely at intervals on the face of the cloth in a like manner to the picks flushing over groups of warp ends in the weft-pile manufactures, but pass over wires, the latter being inserted, in a prescribed order into definite sheds in the warp. Such wires take the place of picks of weft, but unlike ordinary picks or shots, they are withdrawn when the pile ends have been bound by the ground picks securely to the fabric.

In making a cut or velvet pile, the knives at one end of the wires sever the threads of warp transversely as they are forcibly removed from out of the sheds of warp; or grooved wires may be inserted and a knife run along the groove for cutting the pile ends and converting them into short lengths of filament, vertically projecting from the foundation cloth. For making a terry pile, the threads, on the withdrawal of the wires, form loops of yarn serially arranged from selvedge to selvedge of the piece, the depths of the loops being proportionate to the kind of wires employed.

In either case, it is the passing of the selected warp threads over the wires, and the binding of them, on either side of the wires, into the texture, which produces the pile. This being

so, the quality of pile—its length, closeness and richness—depends, first, on the gauge and depth of the wires; second, on the frequency of the insertion of the wires into a given portion of the cloth; and, third, on the set of the fabric and the counts and variety of the pile warp yarns employed.

285. *Weave Plans for Warp-pile Goods.*—The textural plans for warp-pile plushes are compound in arrangement, but elementary in construction. For making a terry or velvet plush, the weave is that shown at A, Fig. 318, in which threads G are the ground and threads P the pile warps, picks 1, 2 and 3 being the ground weft, and W the sheds for the wires.



PLAN A. PLAN B.

FIG. 318.—WARP-PLUSH WEAVES.—(*Marks = Warp lifted*).

It will be seen that all the pile-warp ends are lifted and all the ground-warp ends are depressed for the insertion of the wires; and that the pile yarns are down on picks 1 and 3, or on the picks following and preceding the wires. Further it will be observed that, without the wires being reckoned, the pile yarns interlace $\frac{1 \quad 1}{1 \quad 2 \quad 1}$; the odd ground threads $\frac{1 \quad 2 \quad 1}{1 \quad 1}$; and the even ground threads $\frac{1 \quad 1}{1 \quad 2 \quad 1}$. As suggesting the looming practice for velvet textures in this class of weave structure, the following particulars are given—

Warp: 1 end of two-fold cotton,
1 „ „ silk (two or more threads in a mail) and
1 „ „ two-fold cotton.

Weft: 1 pick of cotton,
1 „ „ worsted, and
1 „ „ cotton.

The silk warp, when not making the pile, is floating two-and-one on the underside of the fabric, and crossed with a worsted weft, a method of intersection which adds to the neatness and softness of the reverse side of the cloth.

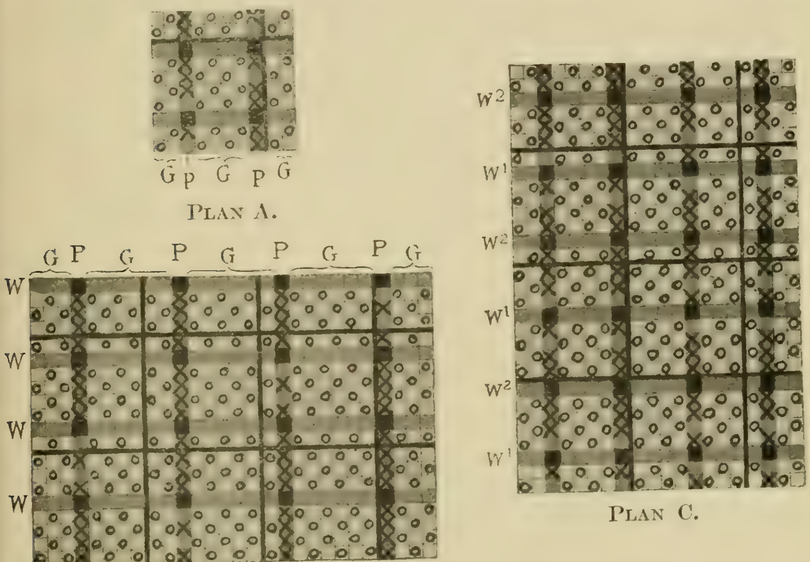
Plan 318B is for a plush of two varieties—length and colour—of pile, threads P^1 making one class of pile, and threads P^2 the other. On the wires W^1, the ground threads and the pile threads P^2 are depressed, with the pile threads P^1 lifted; and on wires W^2 the ground and pile warps G and P^1 are depressed and the pile warp P^2 lifted. As in plan 318A, the pile yarns are covered by the shots of weft immediately preceding and following the wires for binding them into the fabric structure. The pile threads P^1 interlace $\frac{1\quad 2\quad 1}{\quad 2\quad 2\quad}$ and the pile threads P^2 $\frac{\quad 2\quad 2\quad}{1\quad 2\quad 1}$, or the reverse of each other. The ground plan produces a $\frac{1}{2}$ weft mat on the back of the fabric, with the pile yarns interlacing with the mat threads. A method of looming for this order of weave—Fig. 318B—is indicated below—

Warp: 4 threads of two-fold cotton
1 thread of pile yarn (silk or mohair)
for Wires W^1.
2 threads of two-fold cotton
1 thread of pile yarn (silk or mohair)
for Wires W^2.

Weft: 2 picks of cotton
Wire W^1
2 picks of cotton
Wire W^2.

286. *Astrakhans—Warp Principle.*—The curl effects, in warp-pile astrakhans, consists principally of looped yarn, but the mohair threads of which they are formed are not necessarily cut as in weft-curl fabrics. The practice yields a good wearing quality of curl surface, or one in which the curls retain their consistency longer, and more closely resemble natural fur, than in the weft production. The curliness is developed in the mohair threads, prepared, as previously described, by passing them over wires and fastening them regularly into the cloth. The dimensions of the curls are

fixed by the size of the wires, while the method in which the surface of the cloth is covered with the curl effects is controlled by the weave plan. This is constructed on the system shown at plans A, B, and C, Fig. 319. The number of ground threads between the pile or curl yarns differs with the closeness of the curls, and also with the variety of cloth



Plan A.

Plan B.

Plan C.

Fig. 319.—Astrakhan Weaves.—(*Marks = Warp lifted*).

manufactured. In plans A and C there are four ends of ground to one end of pile yarn, but in lighter textures the proportion of ground threads is further increased. Plan A is the standard weave in making medium weight goods to which such weaving data as the following are applied—

Warp: 2 threads of 2/30's cotton (double)
1 thread of 12-dram mohair
2 threads of 2/30's cotton (double)
1 thread of 6-dram mohair.

Weft: 6's cotton
30 ends and shots per inch.

The relative lengths of pile and ground warp yarns for giving a full curl in this setting should be approximately as three is to one.

Plan 319B is illustrative of a second form of construction, that of floating the pile yarns over a larger number of picks, and of providing for a longer structure of curl. It is the type of weave usable when the mohair yarn is printed in two shades, such as black and white, for developing the curls in mingled colouring.

The curl features may, on the warp principle of weaving, be formed in both looped and cut pile as in plan C, Fig. 319. be formed in both looped and cut pile as in Fig. 319C. Here two kinds of wires are used—W^1 and W^2—for cut and to be better stitched than those passing over W^2. But this rule is not always observed, for in some makes of these fabrics the pile yarns are stitched on the same system for both the curl and looped effects.

In two-pile effect cloths the character of the plush is varied with the order in which the two types of wires are inserted in the weaving practice.

287. *Warp Tensioning in Pile Weaving.*—The tensioning and delivery of the warp yarns, in pile and plush weaving, require to be accurately adjusted. The ground warp threads are wound on to one beam, and each sort of pile warp yarn on to a different beam. The tension of the first must be uniform and considerable to admit of the construction of a level and firm cloth. That of the pile yarns should also be fixed throughout the operation of weaving, yet the yarns should be intermittently released and tightened for the wiring and beating up of the picks of weft. As the wires are carried forward by the going part pressing against them, the pile yarns are allowed to take up a length equivalent to the dimensions of the wires. For the movement of the going part, when shuttling the ground picks, the pile yarns are normally tensioned. If the yarns are over-tensioned in the wiring, the pile produced has a tendency to draw out. If

insufficiently tensioned, the pile has a tendency to become irregular on the surface. Further, if the pile yarns are incorrectly tensioned for wefting, they become unevenly interlaced on the back of the fabric. In the production of goods having two or more lengths of pile, each sort of pile yarn is run off a separate chain beam. In figured pile fabrics, in which the pile yarns take up differently in the weaving process, they are delivered off double-ended bobbins mounted in a creel, and each bobbin, or miniature beam, is friction-braked.

288. *Varieties of Figured Pile Fabrics.*—The principal varieties of figured pile fabrics include—

(1) Velvet Pile and Cut Plush Fabrics, with printed pile warp yarns for developing the pattern or design features.

(2) Fabrics with an Ordinary Textural Ground and Terry or Frisé Figuring.

(3) Fabrics with a Simple Weave Ground and Cut Pile Figuring.

(4) Fabrics with a Terry Pile Ground and Velvet Pile Figuring or *vice versâ*.

(5) Fabrics with a Sateen, Repp or Soliel Ground, and with the Figuring in both Terry and Cut Pile.

(6) Fabrics in which the Figuring is developed in different heights of pile—looped and cut—and with various weave structures forming patterns in the ground.

Different schemes of manufacture are applied in producing these classes of pile goods, which are suitable for mantle as well as dress fabrics. The methods of construction adapted to the lighter makes of cloth will be considered, and so far as they are comprised in Classes (1), (2), and (3).

289. *Printed Pile-warp Figuring.*—This principle of pattern production is practised in the manufacture of velvets and plushes of the simple scheme of construction. The surface effects, both as to pile quality and as to pattern style, are varied and rich in composition. The build of the fabric is usually of the character illustrated in Figs. 318A and B. The velvet pile specimen—Fig. 320—is producible in plan

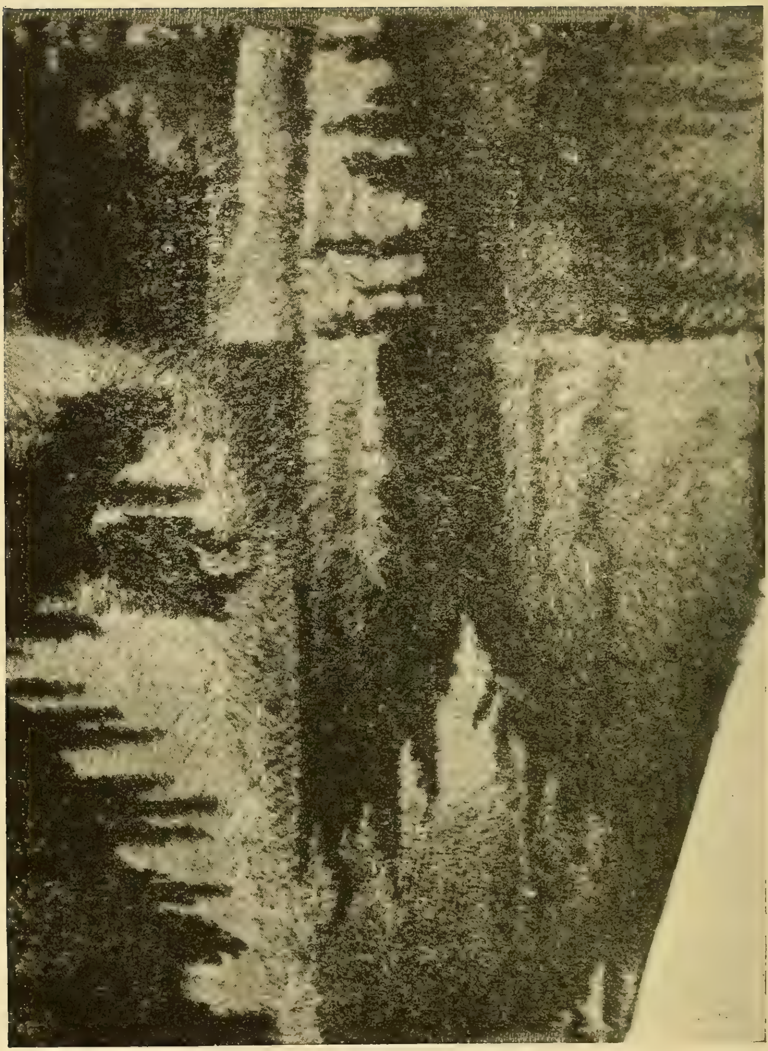


Fig. 320.—Printed-warp Velvet.

A with 120 ground and 60 double-pile ends per inch. The design in this example, and in similar descriptions of velvet or plush, is of the irregular blotched description of figuring so well adapted for getting features, in a pile surface, suggestive of the shaded toning in natural furs. In originating the patterns, all the effects, such as those observed in black, white, and grey tones in Fig. 320, are first drawn in colour to *fabric scale* on point paper. Second, the effects, on each thread in the design thus drafted, are next elongated to the dimensions of such effects in the *warp-yarn scale*, and the design so extended gives the printing scheme.

This method of manufacture and of pattern development, lends itself to the expression of the types of decorative detail suitable for cut pile goods, whether of the velvet or of the mohair plush variety. The velvet structure is used in dress goods and the plush structure in mantle cloths, the latter also in heavier builds of plushes for wraps, rugs, etc. The cut-pile system of weaving imparts softness of toning to the variegated forms in the figuring.

290. *Terry Figuring.*—This is one of the simplest classes of figured pile production. It will be considered in relation to the textural examples in Figs. 321 and 323, one having a twilled ground and woven in worsted yarns, and the other having a silk crepon ground with the pile effects developed in worsted. The pile or plush may be obtained in a different colour of yarn from that applied to the ground portions of the cloth, but such is the distinctive character of the pile figuring from the twilled or other ground surface of the texture, that it is sufficient to emphasize the design elements in both coloured and piece-dyed goods.

The plan of construction of the example in Fig. 321 is given in the sectional designs Figs. 322A and B. As the marks in these plans, and also in those of the series of plans illustrative of figured pile designing, represent weft intersections, it will be understood on examining weaves A and B that when the pile yarns in these textures are not being utilized in forming

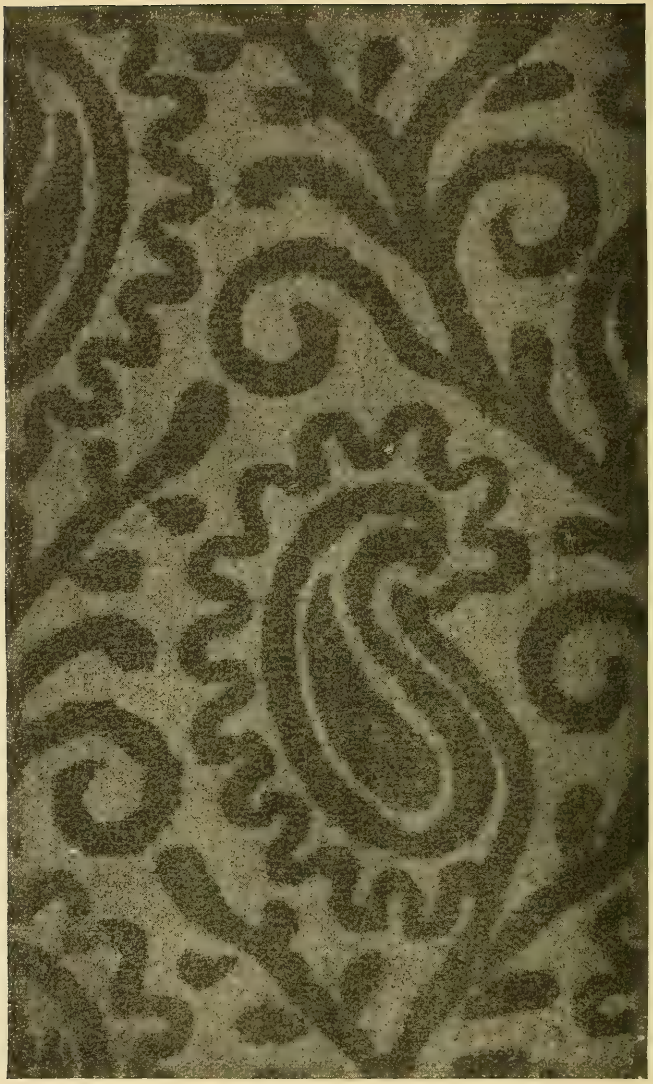


Fig. 321.—Terry-pile Figuring on a Twilled Worsted Ground.

the figure, they are stitched regularly on the under-surface. Thus, in plan A, Fig. 322, all the threads of both the pile and ground warps are depressed on the wire shots, W, with the pile yarns P interlacing $\frac{1}{7}$, and stitched to the $\frac{2}{2}$ twill ground as in a warp-backed cloth. On the wire sheds in plan B all the pile yarns are lifted, and all the ground warp yarns depressed, with the pile and ground threads intersecting with the shots

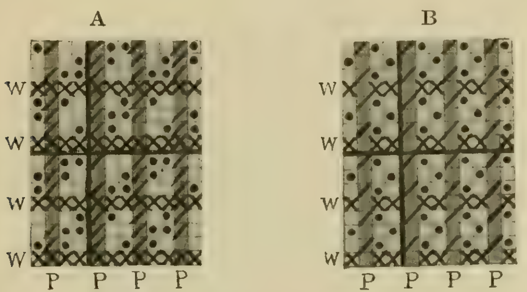


FIG. 322.—SECTIONAL PLANS FOR FIG. 321.
(*Marks = Weft Intersections.*)

of weft on the common principle of warp-pile construction, or that given in weave A, Fig. 318. The weaving practice adopted in making this type of figured terry is—

FIGS. 321 AND 322A AND B.

Warp: 1 thread of 2/60's worsted shade (1) (ground)
1 thread of ,, ,, ,, (2) (pile)
1 thread of 2/60's ,, ,, (1) (ground)
96 threads per inch.

Weft: 2/60's worsted shade (1)
64 shots per inch exclusive of wires.

291. *Terry Pile Figuring on a Crepon Surface.*—In illustration of the applicability of terry figuring to further classes of dress goods, the crepon ground texture in Fig. 323 will be

examined. It is made in silk and worsted yarns, arranged as below—

Warp: 1 thread of 60's two-fold silk (crepon yarn),
1 ,, ,, 2/60's worsted (terry and backing yarn),
1 ,, ,, 60's two-fold silk (crepon yarn),
108 threads per inch.

Weft: 2 picks of 60's two-fold silk,
1 pick of 2/60's worsted,
2 picks of 60's two-fold silk,
1 pick of 2/60's worsted,
1 wire.
72 picks per inch, exclusive of wires.

The crepon effect in the ground or in portions C of the design is woven in a plain silk texture over a plain worsted texture. In the terry effect (marked in ■'s, and in grey in Fig. 323A) the silk threads intersect plain and the worsted $\frac{1\quad 1}{1\quad 2\quad 1}$ between the wires. Further, on the wire shots W in the crepon parts the pile and the ground threads are on the underside of the structure; whereas, in the terry parts, the pile threads are lifted and the silk threads are depressed. The pile yarns, when not figuring on the surface, are making, as shown by the intersection marks in ■'s, a plain texture with the worsted picks. It follows that while the face of the cloth consists of a plain silk ground and worsted pile figure, the back of the cloth is plain in construction in the worsted yarns under the crepon effect, with a plain intertexture in both the worsted and silk threads under the pile effects. The figuring in this specimen is in one colour of yarn, but here, and also in Fig. 321, the pile yarns may be in two shades arranged one-and-one, etc., should a mingled tinted pattern be desired. The relative lengths of the pile and ground warp yarns in Fig. 321 are as 12 is to $5\frac{1}{2}$, and in Fig. 323 as 6 is to $3\frac{1}{2}$. To develop the pile in too long a loop is not a satisfactory practice. It should make a clearly defined terry effect so that this may cover the ground of the cloth, but the loops should be firm and close in structure.

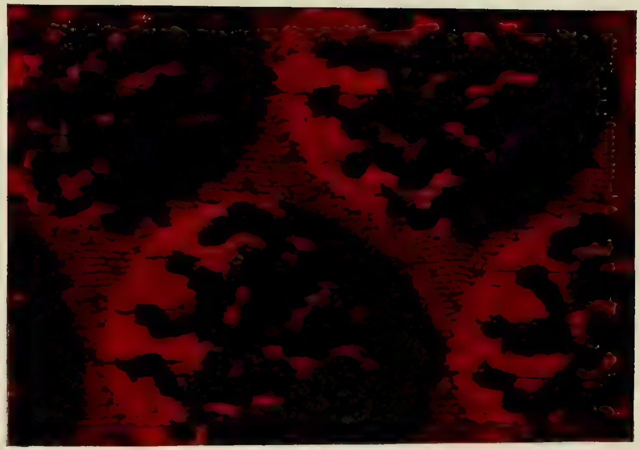


FIG. 323.

SPECIMEN WITH CREPON GROUND AND TERRY-PILE SPOTTING.

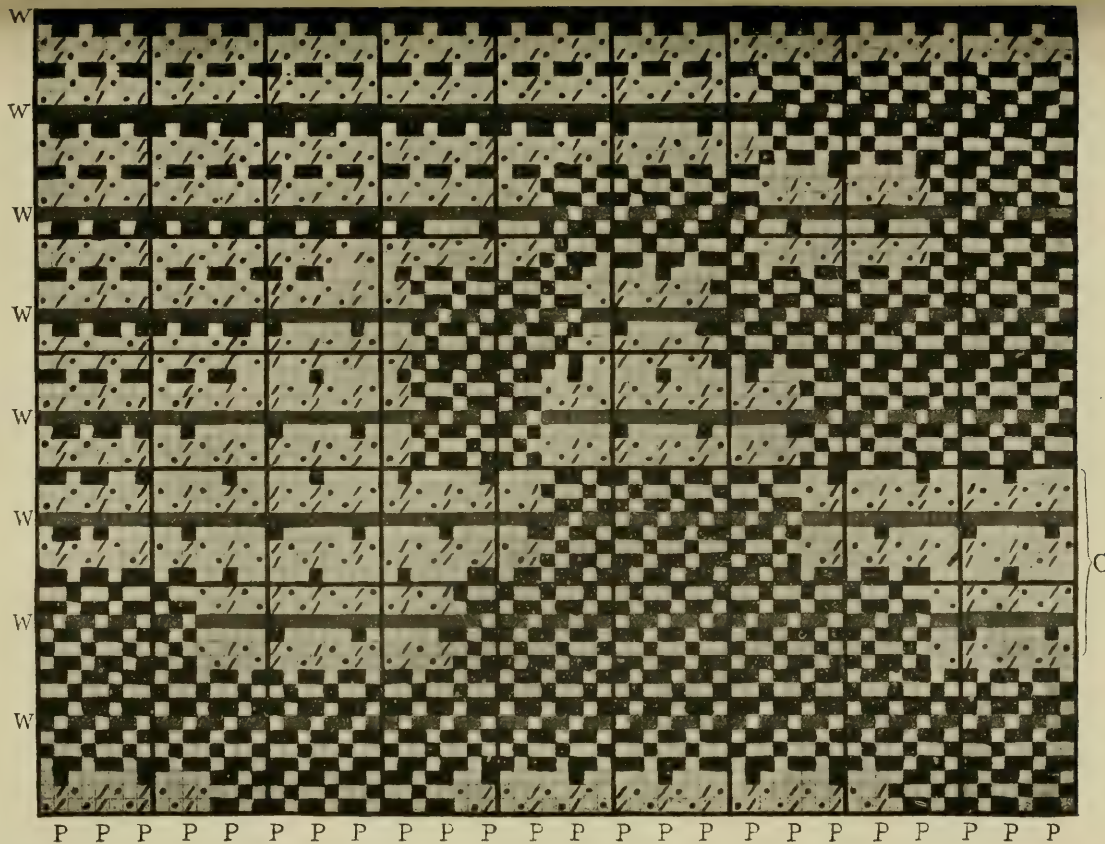


Fig. 323a.—Sectional Design for Fig. 323. (*Marks = Weft Intersections.*)

292. *Velvet or Cut Pile Figuring on Twilled Grounds.*—The pile method of developing the figuring on a twill or common weave ground is illustrated in Fig. 324. For the ground, worsted yarns are used as in the example in Fig. 321, but these are warped and wefted to give a tartan plaid or check, the order of colouring for the checking being—

Ground Warp and Weft—Fig. 324

12	threads	of	60's two-fold silk white,
64	,,	,,	2/60's worsted green,
16	,,	,,	2/60's worsted heliotrope,
8	,,	,,	60's two-fold silk gold,
32	,,	,,	2/60's worsted green,
16	,,	,,	2/60's worsted black,
32	,,	,,	2/60's worsted green,
8	,,	,,	2/60's heliotrope,
8	,,	,,	60's two-fold silk gold, and
84	,,	,,	2/60's worsted heliotrope.

The looming arrangement for this example is as follows—

Warp : 2 threads of 2/60's worsted, coloured as above,
1 thread of organzine silk, 3 threads in a mail,
64 ground and 32 threads (3 as 1) of silk per inch.

Weft : 2/60's worsted, coloured as above.
64 picks per inch exclusive of wires.

Density of pile is got in this setting by having three threads of silk drawn through each mail of the harness, giving the equivalent of 96 single ends of silk per inch in the velvet figuring. The scheme of weave construction is sketched in Fig. 324A. Here, as in the plans for Fig. 321, the pile yarns in the ground of the fabric (section G) stitch on the back, but the pile yarns in the velvet (section V) cover the wires regularly, being stitched on the picks, intervening the wires, with the ground ends intersecting alternately $\frac{\ 1}{2}$ and $\frac{\ 2}{1}$. In this fabric the length of the silk to the worsted yarn is as three to one, giving a soft quality of velvet in the figuring.

It will be observed that the cut pile (compare Figs. 320 and 324 with Figs. 321 and 323) develops the pattern in a richer textural surface than the loop or terry pile. Either one or the other of these principles of looming may be worked into

FIG. 324.

SPECIMEN WITH TARTAN OR PLAID WORSTED-YARN GROUND AND VELVET-PILE (SILK) FIGURING.

striped styles, having successive lines in the designs in twill, silk figuring, and in pile.

The fourth, fifth, and sixth schemes of fabric construction for figured pile designing are different forms of elaborating the principles defined, and are applied more especially to goods produced for the mantle trade.

293. *Lappet Weaving.*—The use of lappet frames (see reference on page 21), operated in front of the sley or reed, provides for the decoration of the surface of the fabric with a supplementary series of warp threads. These are run off special chain beams conveniently tensioned. The control mechanism for the frames is of two kinds, that of a shaped

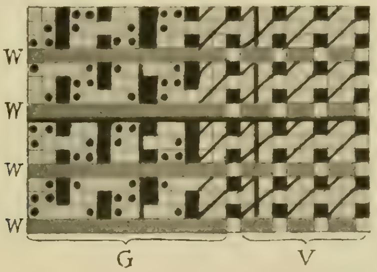


FIG. 324A. SECTIONAL PLAN FOR FIG. 324.

or grooved cam wheel as employed in Glasgow and the districts in which this class of weaving is chiefly practised ; and that of lattice lags revolving on a cylinder, and in which the sections in the lags actuate the levers of different lappet frames. The concentric grooves of the lappet wheel determine the pattern lines as described by the whip threads on the face of the texture ; while the number of grooves on the face of the wheel corresponds to the number of lappet frames employed. The order and length of the pegs inserted in the lags have a similar function as the eccentric forms in the lappet wheel, fixing the stroke or lateral displacement of the frames.

The frames in either system of control are studded with sharply pointed pins from 1 to $1\frac{1}{2}$ inches apart, through the eyes of which the lappet threads pass. Immediately behind

the frames is fixed a shuttle guide or a pinned stave, against which the shuttle runs. This guide, and also the frames, have an up-and-down reciprocating action. On the formation of the shed they rise, enabling the pins in the frame to lift the whip threads so that they form part of the upper half of the shed. Picking takes place at this juncture, after which the frames and the shuttle guide are lowered, the pins and the frames passing in the operation below the warp line or "race" of the going part, and allowing of the sley, in the rear of the shuttle guide, to force the shots of weft into position in the fabric. The frames are thus made to effect the lifting of special warp ends, causing such ends to become units in the upper portion of the shed, and further, to interlace with the picks of weft. In this respect they have a similar movement to the heddles or harness. They do not, however, bring the whip ends into a position where they are covered by the picks, but into a position where the picks float under them, and bind or stitch them into the make of the fabric. The texture is constructed by the ordinary shedding units, with the effects formed by the lappet ends spread and stitched on the face of the fabric thus woven.

For the decorative effects, or for the development of the pattern produced by the whip threads, the frames are laterally displaced at stated periods, and as determined by the control mechanism. This displacement occurs when the lappet frames are out of the warp, that is, when they are below or above the warp line. Either of these practices may be followed, for the frames may be mounted *over* or *under* the warp, but the latter position offers advantages in weaving, in so far as the attendant can repair broken threads, etc., as readily as if the loom were ordinarily geared up.

294. *Swivel and Lappet Effects.*—In some senses, lappet patterns resemble those producible by swivel shuttles. They are added decorative elements and may be inserted into the cloth in detached or spotted units, as in sections A and B and C and D of the lappet specimens in Figs. 326 and 330. Whereas,

however, the swivel is a shuttling appliance and produces the design by means of extra shots of weft which interlace with the warp yarns in the same way as in making a common fabric structure, the lappet is purely a *warp* principle of intertexture. The design forms are developed by the lappet yarns being stitched, after traversing a definite width of the cloth, into the groundwork. Fig. 325 is a magnified specimen of a plain, cotton texture, swivel spotted. Part A is a section of the face and part B a section of the reverse side of the pattern. Here the swivel picks S are seen to intersect the warp ends in plain and also in flushed order. On the right side of the texture only the spotting details are visible, but on the underside (part B) the trailing shots, when not used in making the face effects, are observed. In lappet work the spotting threads, though warp, run in a line with the picks of weft when producing the decorative effects. They do not interlace in plain, twill, or other order with the picks, being merely stitched by them to the fabric. As in swivel weaving, these pattern-producing yarns may trail lcosley between one row of pattern elements and another, or as they would in developing the spottings in Fig. 330. With the frames operating from the lower position, on the completion of one series of such spottings, they are withdrawn from the warp and retained inactive until required for making the second series of figured details. By this arrangement, the floating ends, between one row of effects and another, are on the reverse side of the cloth. Hence, after the piece is woven these loose ends may be cut off, leaving the spotting edges perfect.

295. *Lappet Effects in Light Textures.*—On this principle of figuring and spotting light-woven textures—muslins, crêpe de chine, and gauzes—as well as firmer makes of fabric, may be ornamented. Moreover, the lappet patterns may be either loosely or closely designed and constructed, and yet produced on a delicate and compactly-interlaced structure. This is the case in the example given at Fig. 11, Chapter I, where a

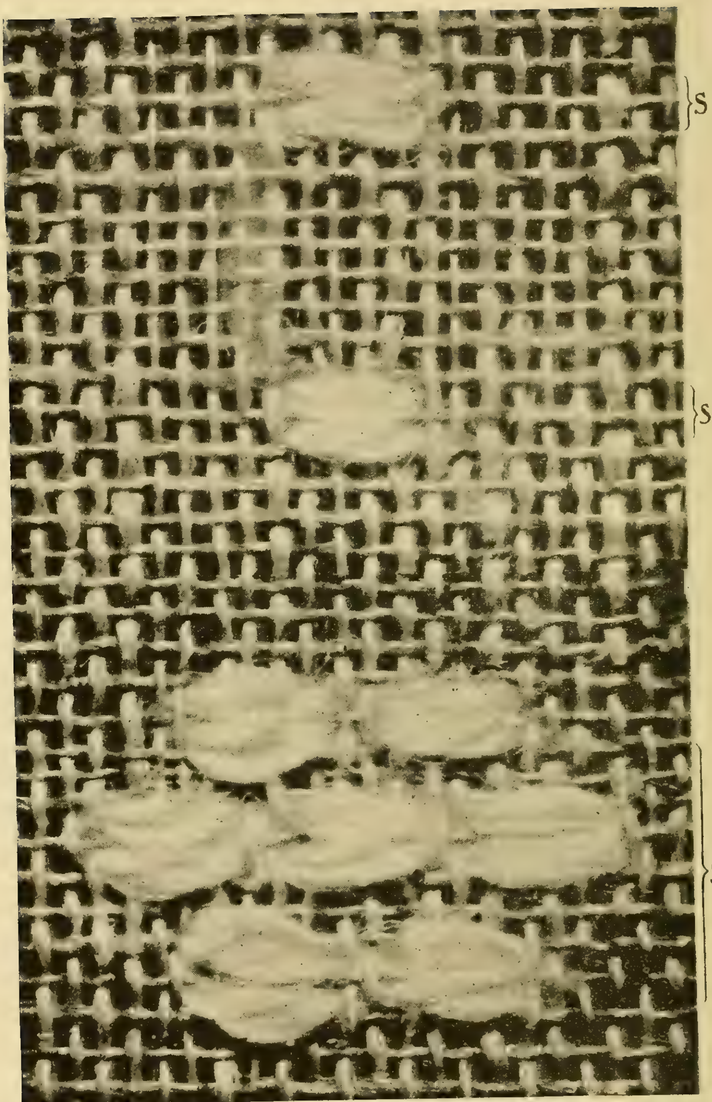


FIG. 325, PART A.—SWIVEL-WOVEN SPECIMEN.

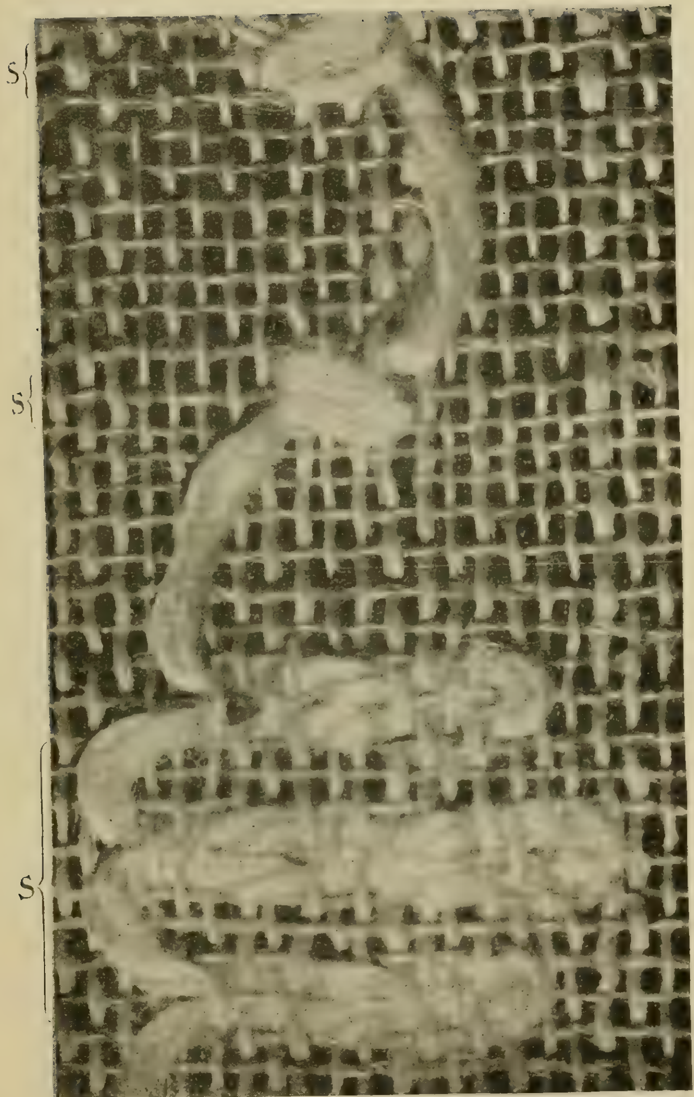


FIG. 325, PART B.—SWIVEL-WOVEN SPECIMEN.

cotton muslin (80 ends and 52 picks per inch) is decorated with a comparatively thick-yarn pattern, made by the employment of three lappet frames, one for striping A, a second for lines B, and a third for the waved types C, between the two lines of effects A and B.

While lappet patterns are restricted in character and style of figuring, the method of their production is economical as

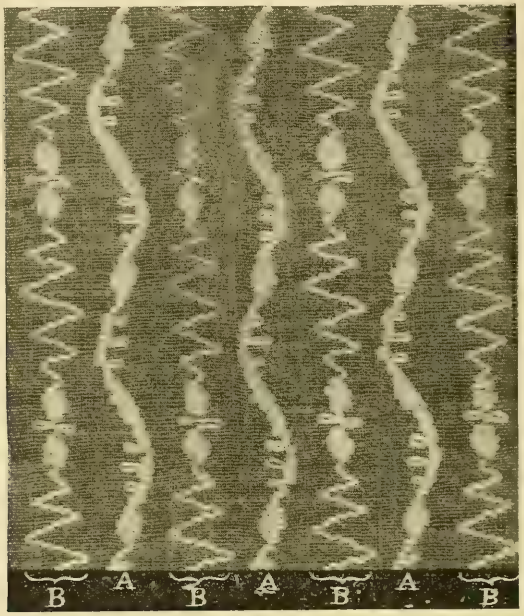


FIG. 326.—TWO-FRAME LAPPET-WOVEN SPECIMEN.

compared with that of extra shuttling. Whether the effects are in one or in two or more colours—(Figs. 326, 329, 330, and 332)—they involve no additional weaving cost beyond that due to the use of two or three lappet frames. The actual cost of fabric production is limited to the set and build of the cloth and to the mounting comprised in the use of several whip-yarn beams and lappet frames.

As seen from the specimens, the pattern features appear to have a weft structure though developed by warp threads.

They closely resemble needle or stitched work, the whip threads bending at the edges in a gimped or vandyked way. Textural decoration, rather than precise design definition, is obtained. Certain simple pattern forms are producible, but these are strictly stitched surface work. It is this factor

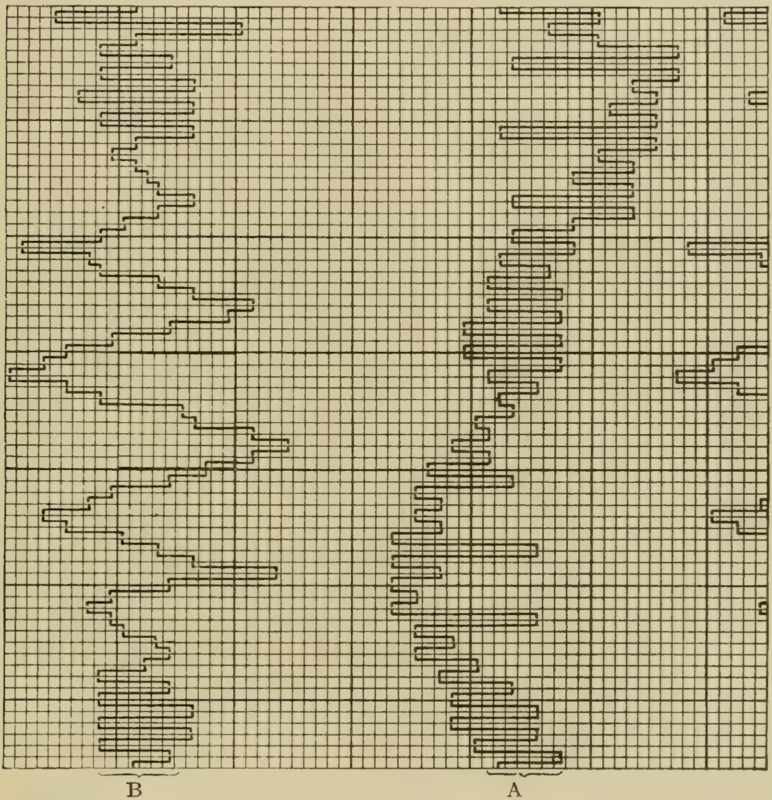


FIG. 326A.

which gives the lappet principle of design its distinctive toning, and renders it peculiarly suited for the lighter makes of blouse textures in both cotton and silk yarns.

296. *Work of the Lappet Frames.*—For each form of effect a lappet frame requires to be employed—each frame, and the whip threads which it receives, being under a separate scheme

of mechanical movement. This will be evident on referring to Fig. 326, for which the design is sketched on "dent" paper at Fig. 326A. The waved striping A and the spotted striping B are here different in formation, hence one frame with the traverse of the lines seen in section A of the plan, and a second frame with the traverse of the lines seen in section B, would be employed. The smaller frame movements correspond with the shortest horizontal lines (equal two dents in Fig. 326A) and the larger frame movements correspond with the longest horizontal lines (equal 15 dents). The double action of the whip threads, first, in traversing given widths of the fabrics and acting as shots of weft; and, second, in rising, when the course of the thread is changed, and acting as threads of warp lifted for binding with the shuttle yarns, is now apparent. In this design, one whip thread controlled by one needle in the frames gives the effects in A, and a second whip thread controlled by a needle of the second frame gives the effects in B. The number of repeats of the effects is therefore the result of the number of pins in the respective frames, and of the width of the piece. The accurate mounting and gauging of the needles are important technicalities. The bars or frames are measured and marked according to the dimensions of the pattern repeat in the set of the reed. In employing several needle bars, the spacing of the combined sets of needles is denoted on a lath of the same length as the bars. On this improvised scale, the position in the loom of each frame is marked, which enables their relative setting to be correctly established.

297. *Two- and Single-Frame Patterns.*—With one frame simple varieties of figuring, such as that illustrated in Fig. 327, are workable. In this example the connection of one row of details with a successive row by the whip thread describing the zig-zag line obviates the cutting away of otherwise loose yarn between the spottings, and produces an additional decorative feature in the cloth. Whatever arrangement of lines is possible within the movements from

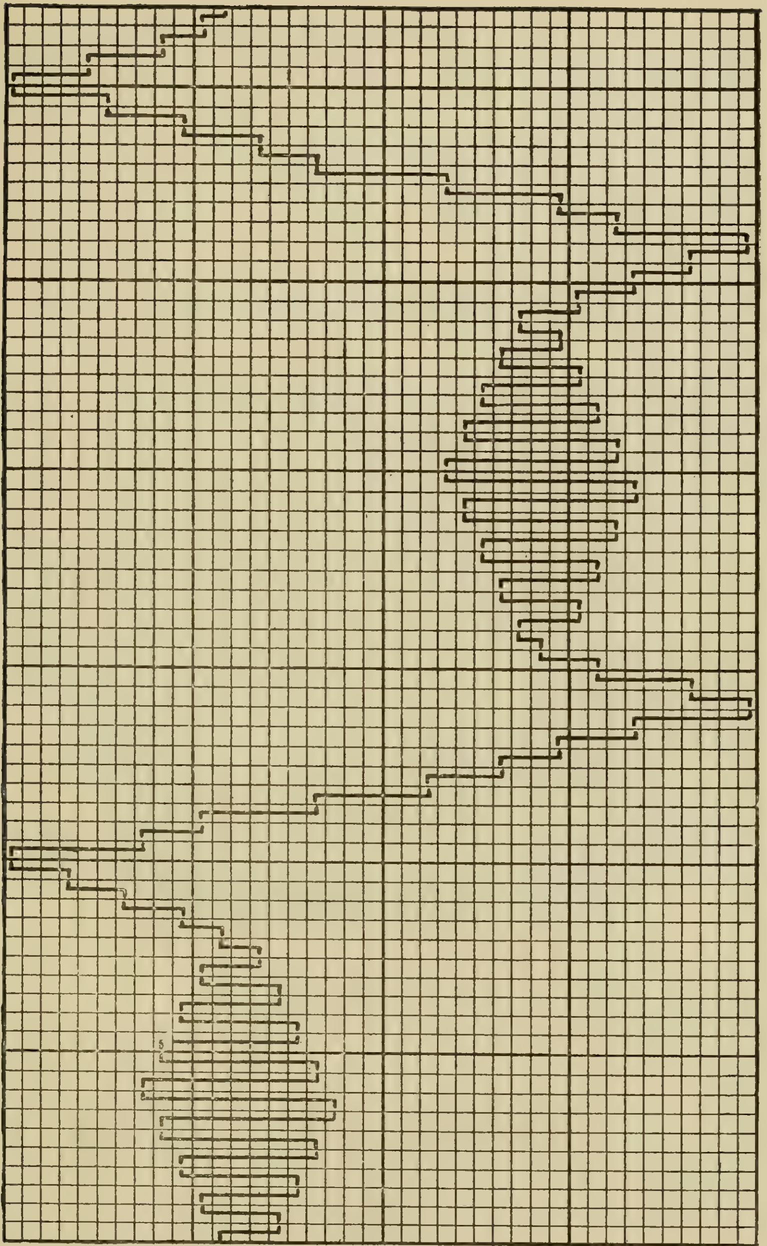


Fig. 327.

centre to centre of a frame, such lines are transferable on to the fabric surface. The order and grouping of such lines follows the rule of weave construction. The designs may also be made on the same principle as ordinary warp and weft patterns by taking each thread on the point paper as the equivalent of a dent, and each pick on the point paper as the equivalent of a single lateral displacement of the frame. The order of wefting, relative to the actuation of the lappet

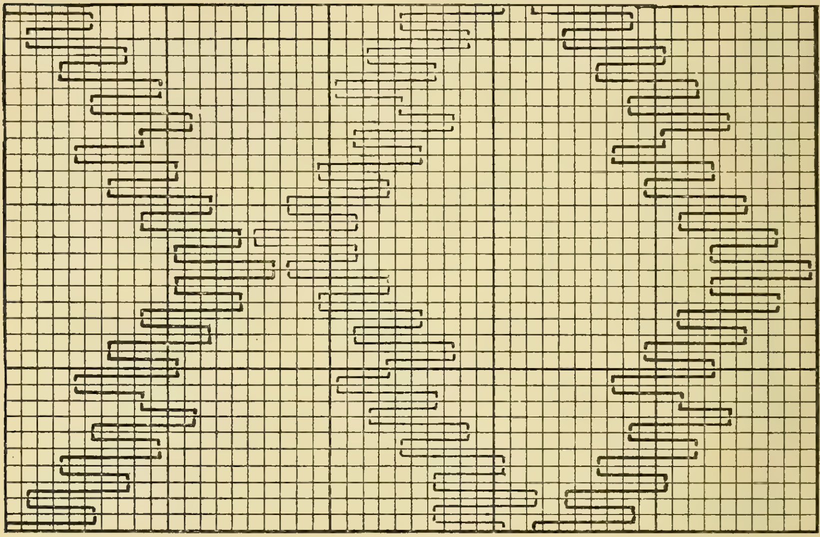


FIG. 328.

frames, is, however, changeable with the fineness of the ground texture, and the sort of lappet style desired.

Two frames provide for the production of reciprocating pattern forms or for the production of diamond and lozenge-shaped figures. An illustration of this type is given in Fig. 328, which suggests the basis on which the style in Fig. 11 (Paragraph 16, Chapter I) is constructed. The configuration of the initial lines in this specimen is first determined, as in originating diamond figures, and second this line is inverted by the action of the second frame, weaving the two effects

FIG. 329.
TWO-FRAME AND TWO-COLOUR
LAPPET TEXTURE.

in one or two colours, or with two or more lines in one colour and a third line of effects in another tint of lappet yarn. Style diversification is acquired by using differently coloured whip threads in each frame. Fig. 329 has been thus produced, the waved line A being in gold whip yarns, and the waved line B in white whip yarns. Taking the pattern lines to be the

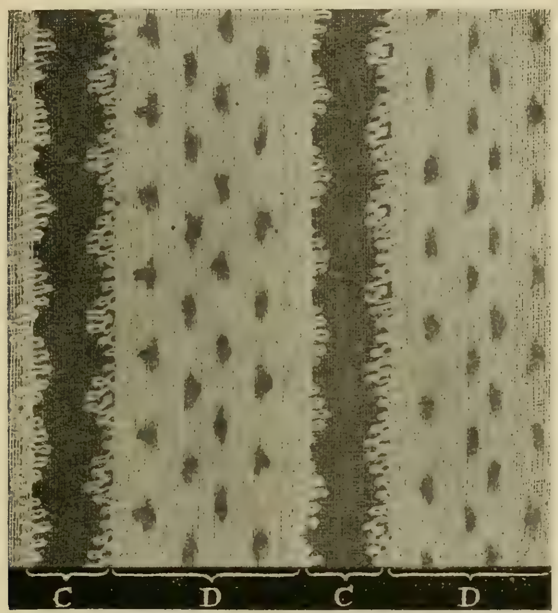


FIG. 330.—LAPPET AND SWIVEL-WOVEN TEXTURE.

same in character, if the lines were coloured in separate tints the design composition would be greatly varied. Moreover, each series of pattern features, such as A or B, Fig. 329, may be differently tinted. For the effects A, two or more colours of whip yarns are usable, producing the same design details in distinct tones in the fabric. Colour assortment and grouping on this system may be practised in modifying the effects of any particular scheme of frame movements.

298. *Gimped and Waved Designs.*—Gimped and waved-line types of design are shown in Figs. 330 and 332. Those in the

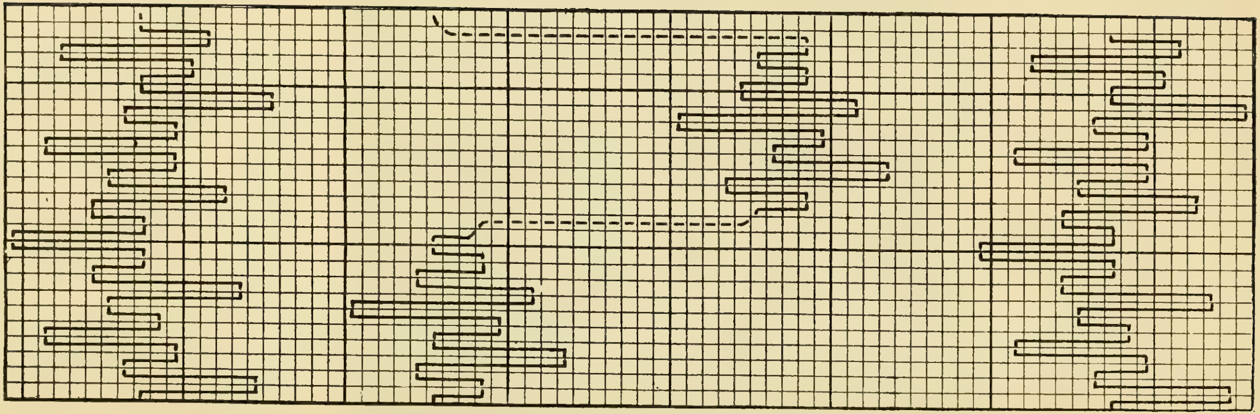


FIG. 331.

former, with also a sectional part of the spotted striping, are outlined on dent paper at Fig. 331. The dotted line, connecting the two spots together, is the portion of the whip thread which would be removed after weaving. By employing a front and back frame the duplicated waved line stitching, at C in Fig. 332, has been acquired. Another characteristic

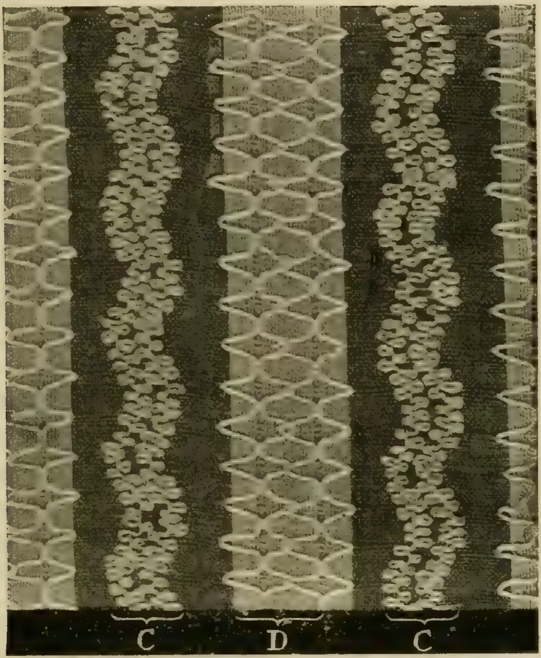


Fig. 332.—Lappet and Gauze Striping.

noticeable in this specimen is the crossed whip-thread features in portion D, resulting in an effect similar to that obtained in gauze heald-shaft mountings. Where the spaced lines occur in this pattern—formed by allowing vacant reeds in the sley—the whip ends of the two frames come together without crossing, whereas, in the intermediate portion of the striping, the lappet ends bind with each other. More accentuated waved lines than observed in this example, are fashioned by

using a special cord yarn. This yarn is not bound into the fabric by being crossed with the weft, but is secured thereto by the lappet end with which it is combined. The latter moves in the formation desired, or as fixed by the plan, and carries the cord yarn with it.

Several methods of diversifying lappet styles, in addition to that of originating new pattern forms, are practised—first, different coloured whip threads may be employed on the same frame as explained; second, the spacing of the needles may be modified giving one repeat of the pattern in broader features than another; third, in multi-frame designing the relative positions of the needles in the frames may be interchanged; fourth, particular frames may be rendered inoperative for definite periods in weaving; and, fifth, two or three of these practices may be amalgamated.

299. *Gauze Principles of Intertexture.*—As pointed out in Paragraph 15, Chapter I, in the gauze principle of weaving, certain threads of warp are made to partly wrap or twist round adjacent threads of warp singly, in pairs, or in selected groups. What actually occurs in the weaving of the fabric is the lifting of the "doup" or "whip" threads on the respective sides of the stationary or standard threads, and the binding of the two sets of warp yarns in this relation by the shots of weft. Leno is commercially a texture in which the open effect is apparent, but not necessarily a gauze structure as understood by the raising of the "whip" threads in alternate order on each side of the stationary threads. In the leno, as strictly defined, a plain pick is inserted between each cross-binding of the threads, whereas, in the true gauze, there are no such plain interlacing picks, but only the picks inserted into the cross sheds of the warp.

The fundamental principle of intertexture, in gauze weaving, is for the picks of weft to cover all the stationary ends—or, inversely according to whether the texture is woven face or back up—and to float under all the doup or crossing threads, as seen in the sketches of the gauze and cellular make of

fabric at F, Figs. 334 and 335. The doup threads D in both these textures are bound to the ordinary warp threads S, by rising successively on the right and left of the latter, and by the picks securing them in these positions.*

300. *Cross-Thread Features—Healding Methods.*—To obtain these cross-thread results, a particular form of duplicated heald is employed, that shown at H^1, Fig. 333A, and the threads of warp are healded in a special way. The doup or slip is attached to the front standard H^2, and may be operated independently of, or in combination with, this shaft. In the "bottom doup" arrangement the slip heald is connected with the lower portion of H^2. Both the upper and lower slip-heald arrangements are largely employed. A drawback in "bottom douping" is that the fabric is produced reverse side up, and should the slip healds break, repairing is not so conveniently done as in "top douping." Moreover, with the top doup the fabric is woven face up, rendering faults and irregularities in weaving at once visible. In addition, the angle of the threads formed in developing the cross sheds is less acute in the employment of the top than of the bottom doup, and this reduces the strain on the warp yarns in the construction of the cloth.

The method of healding, and plan of construction, are exemplified in Figs. 333 and 334, and also in the sketch of the shaft mounting for plain gauze in Fig. 333A. Referring to Fig. 333, the ordinary threads S pass under the vibrator, slackener or easer V, and over the warp rest WR, thence through the healds of the regular heddle H^3. The doup threads D pass over the vibrator V and WR, through the healds of the back standard H^4, under threads S and through the doup healds H^1. The warp yarns are thus divided into two classes, those healded straight or threads S, and those double-healded or threads D, with the doup ends crossed under the stationary ends between the back standard H^4, and the front standard and slip or doup, shafts H^2 and H^1. The

* Gand's *Cours de Tissage*, Nesbit's *Grammar of Textile Design*, and Schams' *Handbuch der Weberei* contain useful diagrams of Gauze Mountings and Textures.

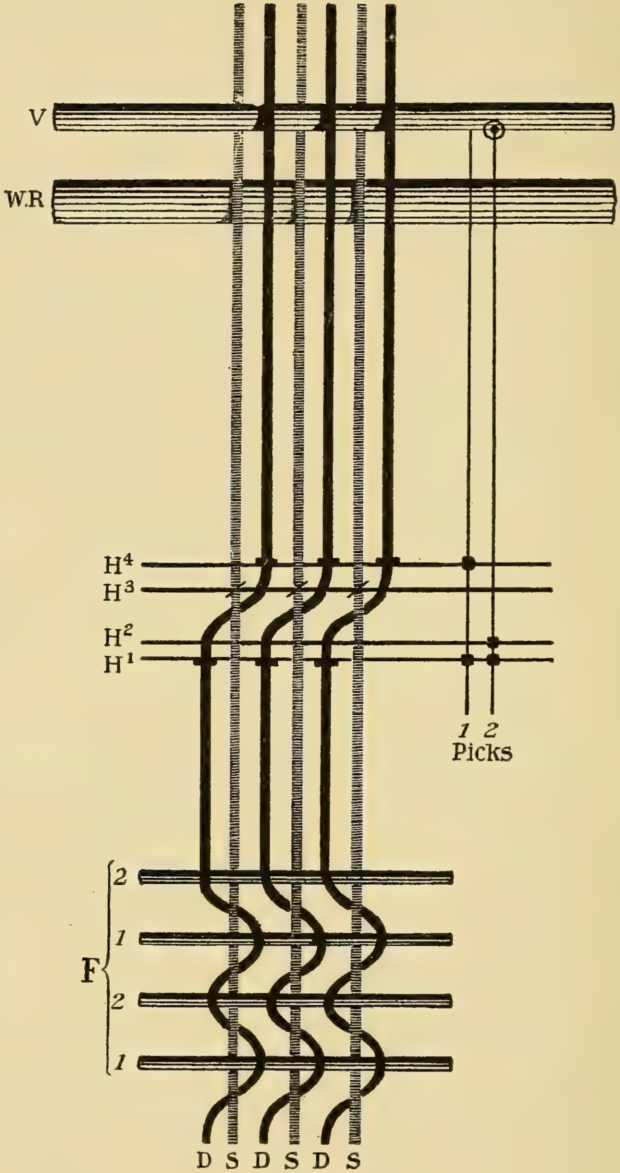


Fig. 333.—Gauze Mounting and Fabric.

lifting of the back standard produces an "open" shed with the threads D raised on the right of threads S, or it produces the shed for pick 1; and the lifting of the front standard produces a "cross" shed with the threads D raised on the

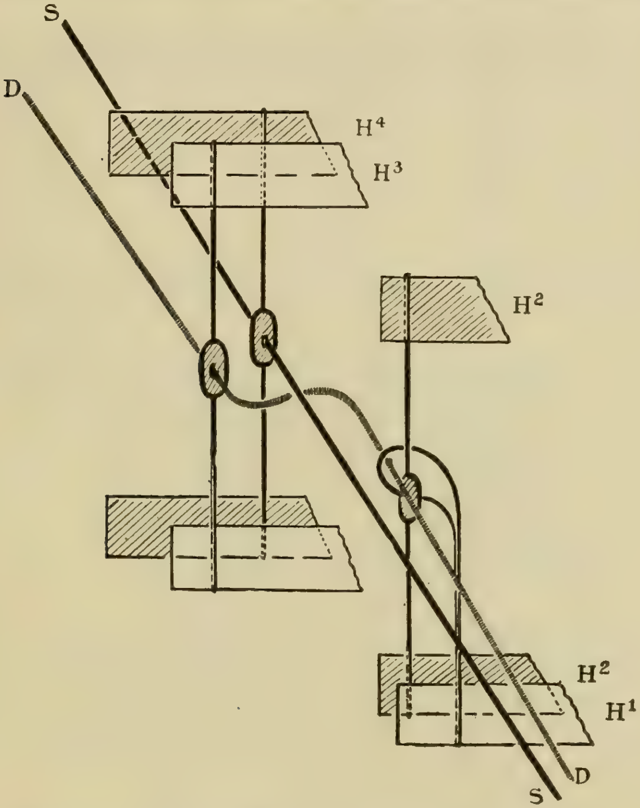


FIG. 333A.—HEALD-SHAFT MOUNTING—PLAIN GAUZE.
(With threads D drawn through threads H^3 and H^1.)

left side of threads S, or the shed for pick 2. Necessarily, in forming the "cross" sheds there is more strain put on the warp than in forming the "open" sheds, and in order to ease the formation of such sheds, the slackener or vibrator V is raised with the front standard and slip shafts. This is shown in the weave plan indicated on the lines corresponding to

shafts H^1, H^2, H^3, and H^4, and also on the line of the vibrator bar V. Marks, representing "lifts," give, on pick 1, the slip H^1 and back standard H^3 raised; and, on pick 2, the doup and front standard shafts, H^1 and H^2, and the slackener raised.

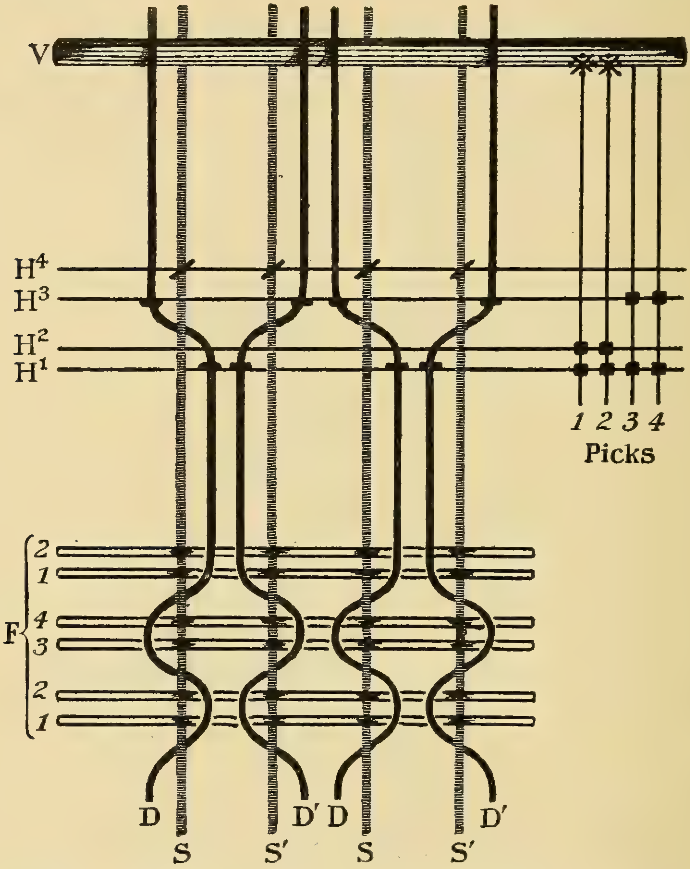


FIG. 334.—HEALDING DRAFT AND PLAN OF CELLULAR FABRIC.

301. *Right and Left Whip Thread Drafting.*—When healding or drawing-in the warp, the doup threads may be passed either to the left or to the right of the stationary threads in the intervals between the back standard and the front standard; or such threads may be alternately passed on one or the other

side of the stationary threads. In the arrangement for the two-pick in a shed cellular cloth in Fig. 334A (warp 2/30's cotton, weft 15's cotton with 30 threads and 50 picks per inch), the doup threads are healded in both directions relative to the ordinary warp threads, or as sketched in the diagram of the mounting for the cloth at Fig. 334. Here threads S pass through the healds of H^4 (ordinary heddle), and the douping threads D through the healds of H^3 (back standard) underneath and to the right of threads S, and the doup threads D^1 through the healds of H^3, and under and to the left side of threads S^1. Left and right intercrossing of the threads in this manner gives a double curve to the doup yarns and yields a cellular cloth structure. As in Fig. 333 the weave plan—Fig. 334—is

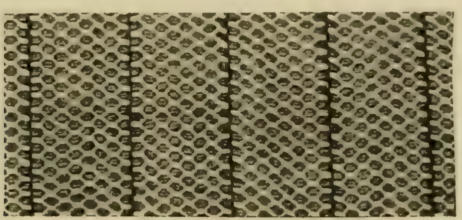


FIG. 334A.—CELLULAR CLOTH.

shown on the heddle and vibrator lines. This shows H^1, H^2, and V as lifted for making the cross sheds or picks 1 and 2, and H^1 and H^3 as lifted for the reverse sheds or picks 3 and 4.

302. *Cellular Cloths.*—A variation of the cellular type of fabric is sketched in Fig. 335. It is weavable in the same shaft mounting as Fig. 334A, but with a different order of shedding and shuttling. Picks 1 and 2 correspond in interlacing with the same picks in Fig. 334, but on picks 3, 4, 5, 6, and 7, the doup, as well as the stationary threads, are intersected plain. For obtaining these effects it will be observed that in the plan the back standard is lifted with the doup shafts on picks 3, 5, and 7, and the regular heald shaft lifted on picks 4 and 6. From the diagram it will be understood how the gauze structure may, as required, be combined with a plain-woven structure.

It should be noted that the practices in healding and in shedding described involve the reeding of each group of yarns, making the gauze effect, in one dent. The open

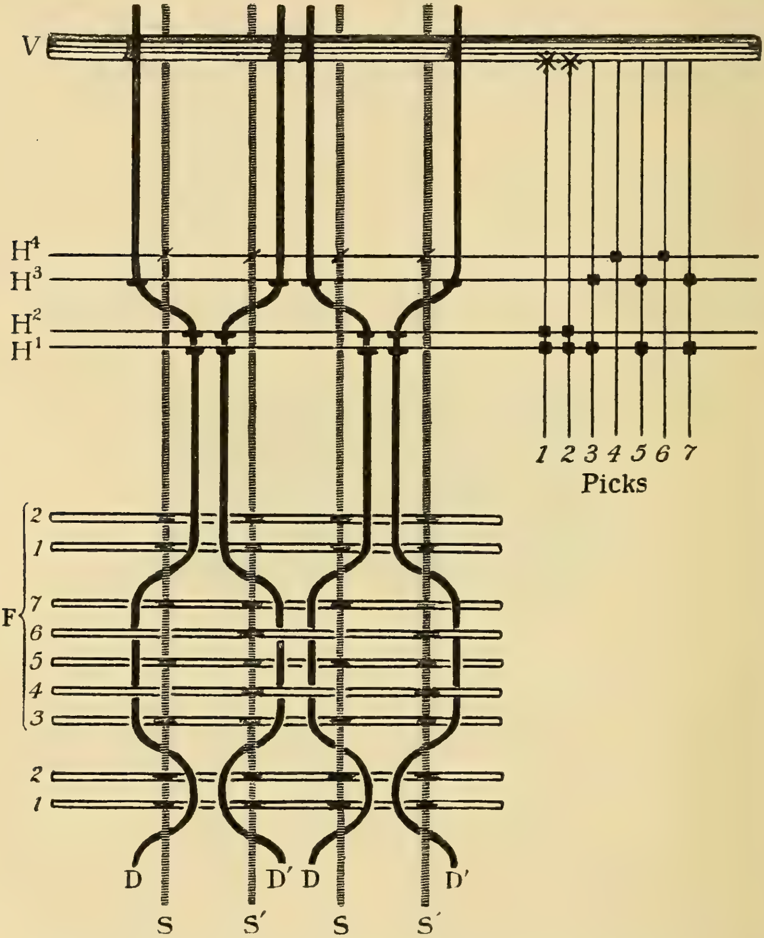


FIG. 335.—DIAGRAM OF CELLULAR MAKE OF GAUZE TEXTURE.

character of the gauze is emphasized in special makes of textures by allowing vacant dents between different sets of gauze ends.

303. *Light Fabrics—Perforated in Structure.*—It is now

evident that cross or gauze weaving enables fabrics of a semi-transparent, as of a more or less perforated structure, to be produced. In the ordinary build of cloth, compactness or closeness of thread interlacing is synonymous with firmness of cloth construction or build. The greater the frequency with which the threads of warp interlace with the shots of weft, the higher the tensility and wearing strength of the fabric woven. To modify or impair these conditions implies the production of a lighter, but also of a more flexible and flimsy make of texture. As the interstices between the crossing of the yarns become better defined, the more readily may the threads be unravelled and disarranged.

On the gauze principle of textural formation, visible spaces occur between the warp and weft threads, and yet the fabrics are firm, fast, and durable in character. The lacing, gauze, or leno yarns in the warp, intertwine (as explained in Paragraph 299) with adjacent threads, and form in the cloth a species of netted or honeycomb effect. The texture may be gossamery and flimsy as in the gauze muslin, but the threads retain their normal positions under tension, friction, and strain. The ordered arrangement of the yarns, as fixed in the process of weaving, is more prominent than in the common types of fabric. For this reason leno threads are inserted into light goods for preserving the lines of the pattern, especially when these lines are obtained by combining closely-interlaced with loosely-interlaced or unintersected details, as in the check specimen in Fig. 336. There being no warp threads in parts C and D of this fabric to intercross with the weft shots C^1 and D^1, if the picks were not bound at the edges of lines A and B by leno-woven threads, they would be easily disturbed and made to leave, in the wear of the fabric, the positions assigned to them in the process of weaving. The higher crossing efficiency of the gauze, as compared with the ordinary principle of thread interlacing, is seen in this example, where the gauze threads compactly bind or knit the edges of the open or loosely-woven pattern features.

In fine silk and cotton goods, as also in cloths made of thicker yarn counts, the gauze practice is adapted to the manufacture of fabrics with a pierced structure and successively close and open in thread composition.

It is this possibility of making a well-arranged and permanent fabric build which is open in character or with spaces between the crossing of the threads, which renders the leno scheme of looming so effective in producing the lighter varieties of woven manufactures. Three examples of such goods are given in Figs. 337, 338, and 339. Section A of the first specimen contains 36 ends per inch of 2/80's cotton, wefted with 40's single cotton and 60's silk, with 62 picks

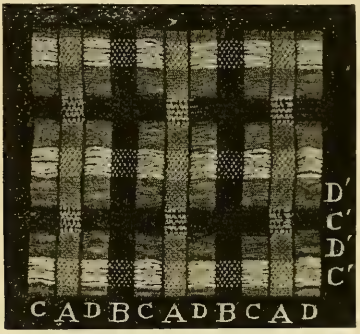


Fig. 336.—Check with Sections edged with Gauze Threads.

per inch. As a texture, it is perforated and apparently flimsy in structure, but in reality quite as durable as the closely set stripe B with 140 threads per inch. The method of thread interlacing is that of the simple gauze (Fig. 333) so that the intertwining of the warp yarns for the insertion of the picks of weft knits the two thread units into a fast make of fabric.

The employment of 2/20's cotton yarns, and crossing them on the system indicated in Fig. 338, bends the shots of weft out of the true horizontal line, and leaves open spaces between both the threads of warp and the picks of weft, resulting in a texture composed of semi-circular pattern forms. The plan of construction here is that shown in Fig. 338a. Two pairs

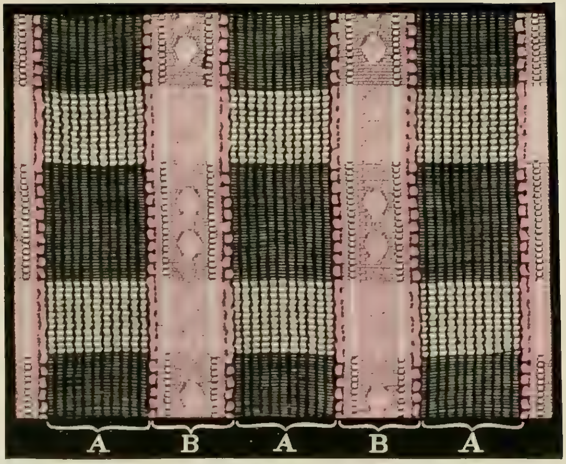


FIG. 337.

MUSLIN GAUZE WITH FIGURED-WARP STRIPE INSERTION.

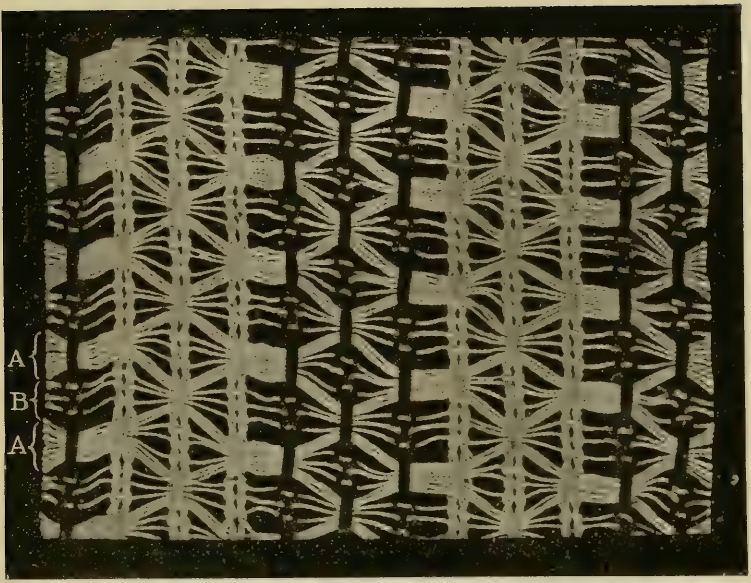


FIG. 338.—OPEN GAUZE STRUCTURE.

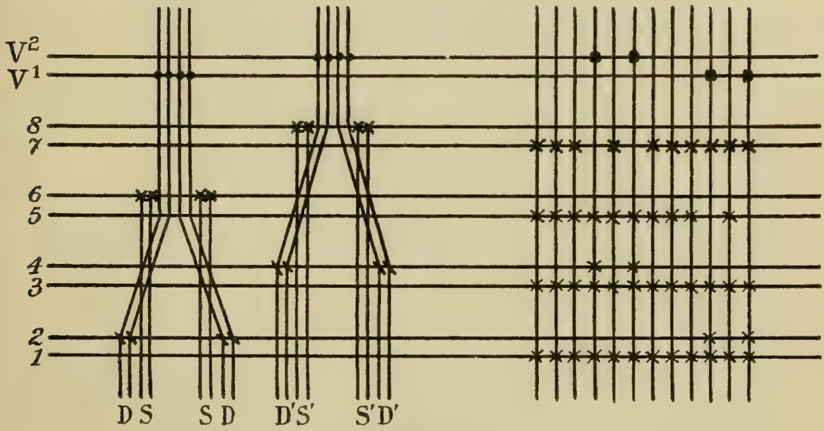


FIG. 338A.

of doup threads, D, D^1, wrap with pairs of standard threads, S, S^1, in interchanged positions, and also in two directions as denoted in the healding draft and plan, and as observed in the specimen. In parts A, Fig. 338, the crossing threads are bound by eight shots of weft, and in parts B by picks alternately intersecting with the threads. It follows that in section B the picks are separated and spread, while in section A they are compacted and forced into waved-line contact with each other. As the two sorts of textural effects counterchange with each other in the length and width of the fabric, successive close and open interlaced features result. The example is illustrative of the extent to which the picks of weft

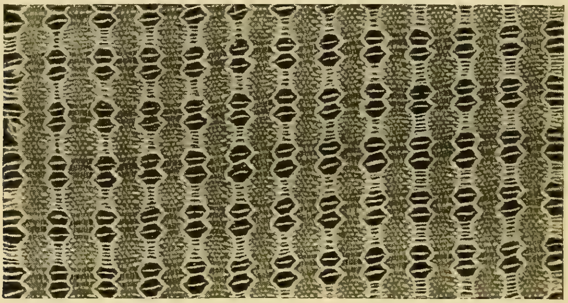


FIG. 339.—NETTED EFFECTS IN GAUZE TEXTURE.

may be drawn out of the straight-line position in cross weaving, and also of the degree of thread spacing producible in an evenly formed and symmetrical make of cloth.

The textural elements described in reference to Figs. 337 and 338 are solely due to the gauze principle of intersection, but in Fig. 339 plain effects alternate with leno or gauze effects. The grey stripings, being in plain, and the white stripings in gauze, the whip threads permit the curved displacements of the yarns observed in the specimen, and also in Fig. 339A. By omitting dents between the whip yarns in the respective lines of effect, the elongated perforations in the fabric are exaggerated. The binding of the doup ends, where crossing, slightly reduces the closeness of the picks. On the

intervening picks, the gauze ends bind plain with the ends in the grey stripings, as will be noticed in the sectional drawing of the yarns in Figs. 339A.

304. *Muslin Striping with Gauze Lacing Threads.*—The pattern in Fig. 340 is typical of the manner in which the whip-threads, in cross sheddings, are made to retain the shuttling yarns in the identical relation given to them in the weaving

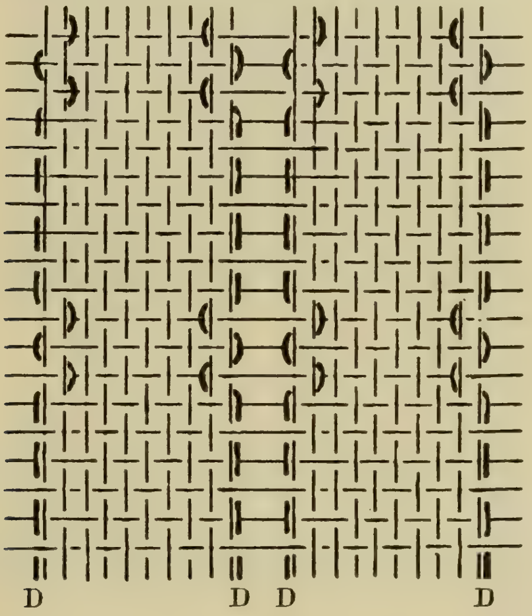


FIG. 339A.

operation. In the specimen, the sections in plain, and also those in lacing, are forcibly developed by the intermediate sections in loose picks of weft obtained by vacant splits in the reed. The method of loom mounting followed in making such styles is illustrated in Fig. 340A. The doup threads, being woven plain on the picks intervening the cross sheds as in Fig. 339, are in such parts of the design alternately lifted by the shaft 7 and by the front doup shaft 2 through which they are drawn. The close character of the plain

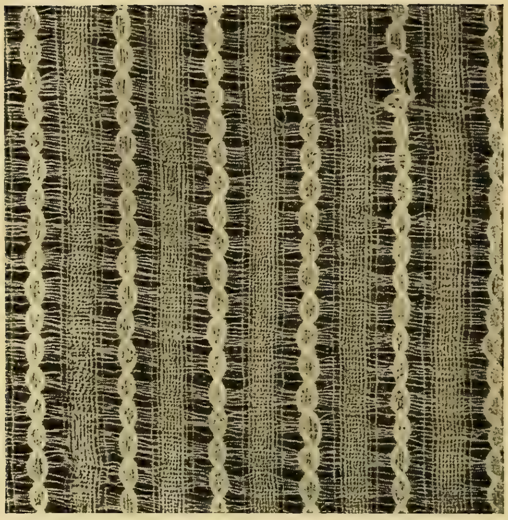


FIG. 340.—GAUZE AND DENTED STRIPING

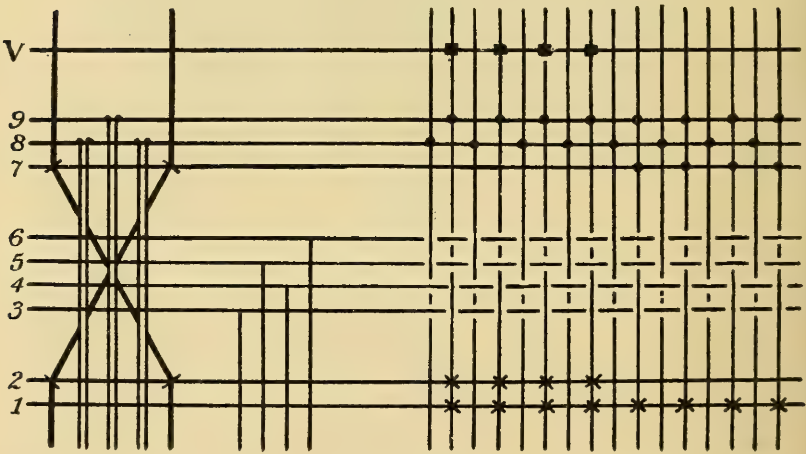


FIG. 340A.

stripes is caused by the warp threads in these portions of the pattern interlacing in pairs. The plain weave is healded on to four shafts in 4-end sateen order, for easing the shedding in weaving, and for ensuring the ready construction of a correctly woven piece.

305. *Sateen and Gauze Striping.*—Fine striped goods are

FIG 341.—GAUZE AND DENTED TEXTURE WITH SATEEN STRIPING.

produced, in which mercerized cotton or artificial silk threads form sateen lines, as in the smartly-developed pattern in Fig. 341. Successive lines are also combined, on this principle, of leno, plain and sateen effects, and also of effects obtained by open denting. The reeding—number of threads in a split—is made to agree with the production of an even texture. This example averages 60 ends per inch in the sateen, and 8 whip and 32 standard ends per inch in stripings S. Between the

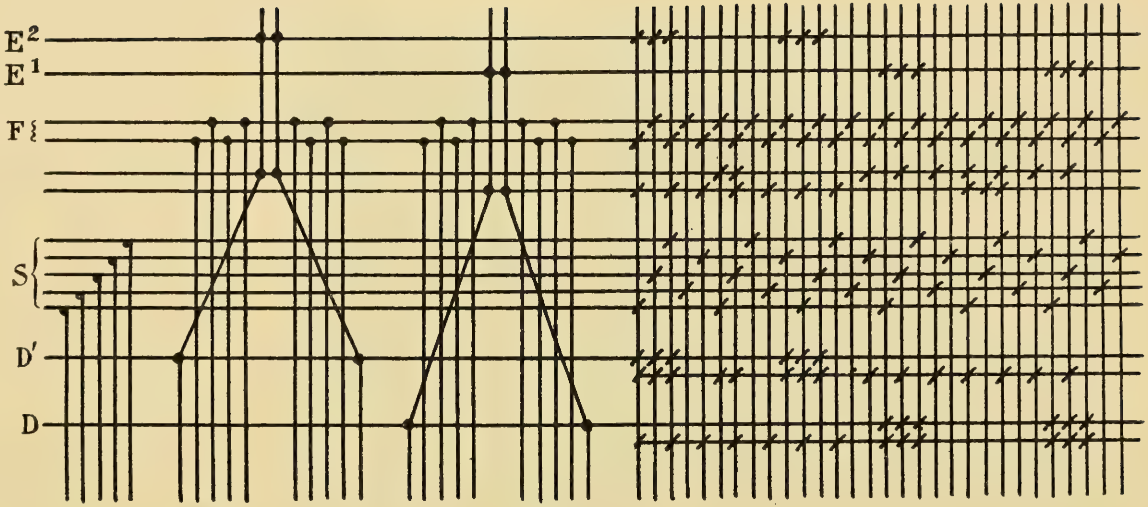


FIG. 341A.

crossing of the leno threads, the picks are unintersected, but formed in straight lines, being held in this relation by the four standard threads, woven plain, and by the wrapping of the latter with the gauze threads. The design, as seen from Fig. 341A, contains 30 picks in the round. Two doup shafts, D, D^1, and two slackeners, E^1, E^2, are necessary for giving the two lines of gauze work. The plain ends, with which the doup threads wrap, are on the two back heddles F, and the sateen striping ends on the central shafts S.

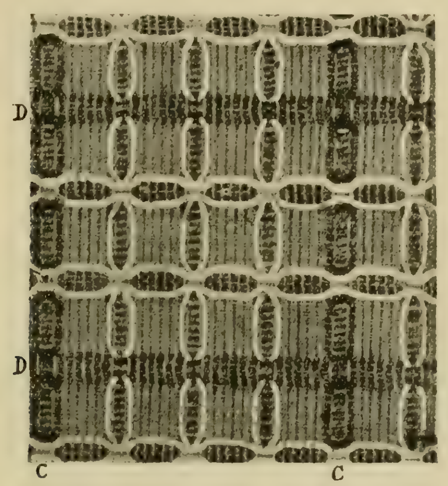


FIG. 342.—GAUZE CHECKING.

306. *Checked Gauzes.*—Checked gauzes—in which the thick leno threads and picks are made to give semi-circular forms of pattern—are produced in designs arranged on the system sketched in Figs. 342A and 343B, the healding draft and weaving plan respectively for the style in Fig. 342. Parts A in the draft, and also in the full looming design, yield the finer, and parts B in the more open, crossing details. Additional prominence is given to the checking lines in this instance by inserting dark ends and picks into the warp and weft of portions C and D of the fabric, which yarns contrast forcibly with the small and thick light yarns making other

sections of the pattern. As will be observed from the healding draft, the whip threads in A work in pairs with the standard threads, but in B three whip threads intertwine with two stationary threads. The actual bending out of the straight

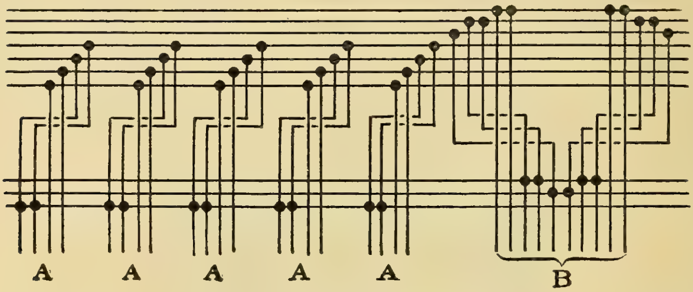


FIG. 342A.

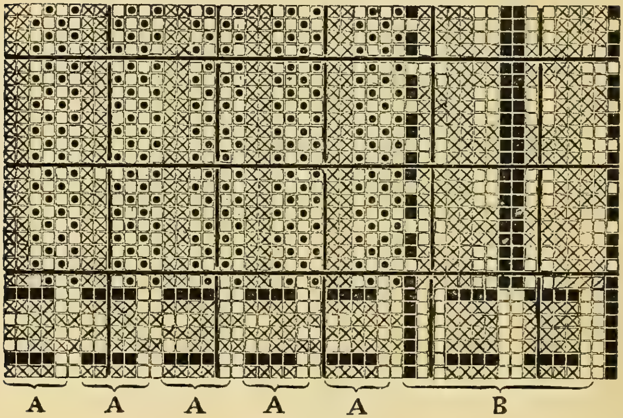


FIG. 342B.

line of the thick picks is accentuated by the weave plan cr by the structural interlacings marked in ☒'s. While the method of operating the slackener or vibrator is not shown here, nor in Figs. 343A and B, it will be understood that such vibrators would be employed and are raised for the cross sheds in weaving the goods.

307. *Extra Weft Spotted Gauze Textures.*—Extra weft spotting in gauze cloths is obtained by the same designing practice as in ordinary makes of fabric. The lappet principle is also utilized for developing spotted and trellis-like figuring. The spotting may be swivel inserted, or woven into the pattern by using extra shuttling. If by the latter method, the loose

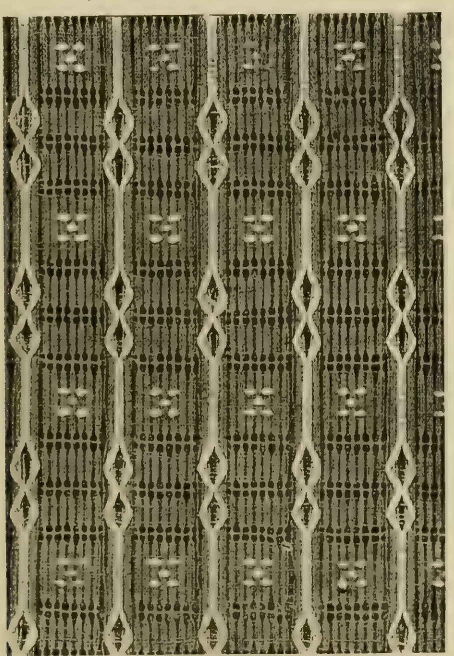


FIG. 343.—EXTRA-WEFT SPOTTED GAUZE CLOTH.

shots on the back of the fabric would be removed after the weaving. The full design, with the extra spotting picks inserted, is given for the specimen in Fig. 343, at Fig. 343A, but, as is obvious from the healding draft, Fig. 343B, the pattern is weavable on seventeen shafts. Two doup heddles are used, namely, one for the whip thread wrapping round the six ends interlacing plain, and the other for the whip threads forming the gauze effect with the ends on shafts eight, nine,

twelve, thirteen, sixteen, and seventeen. Sections A should be repeated twice on both sides of section B. The thick douping threads are 3/20's cotton. The rest of the yarns are 2/40's, with 66 threads and shots per inch. The extra picks are

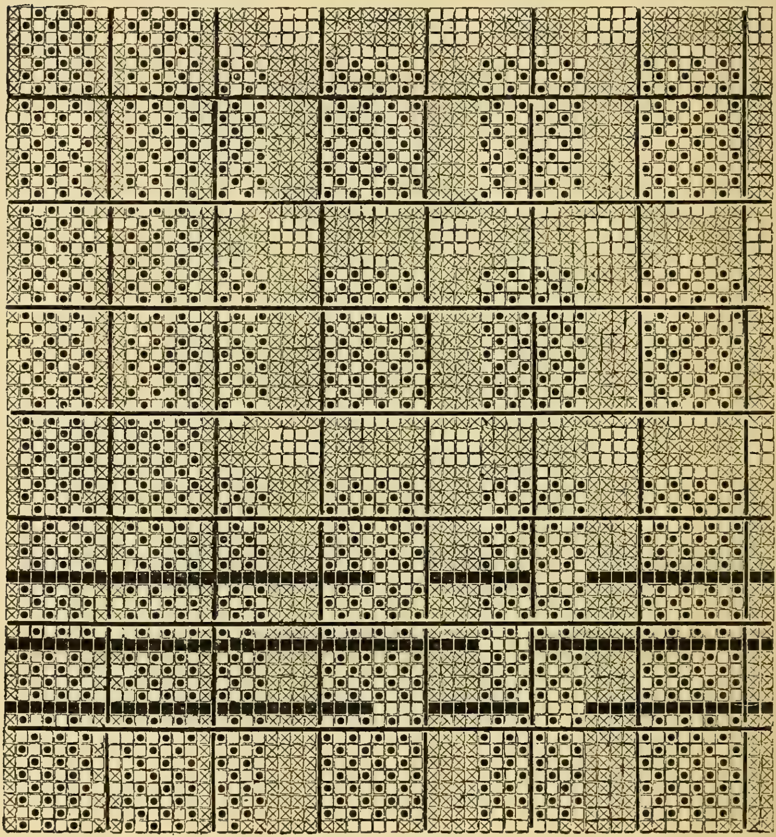


FIG. 343A.

marked in ■'s, and float under the threads of warp when not producing the spotting, or to the extent indicated in the plan in which the marks represent threads depressed.

308. *Warp Figuring in Gauze Patterns.*—Figuring in special warp yarns, in both dobbie and harness mountings, is done

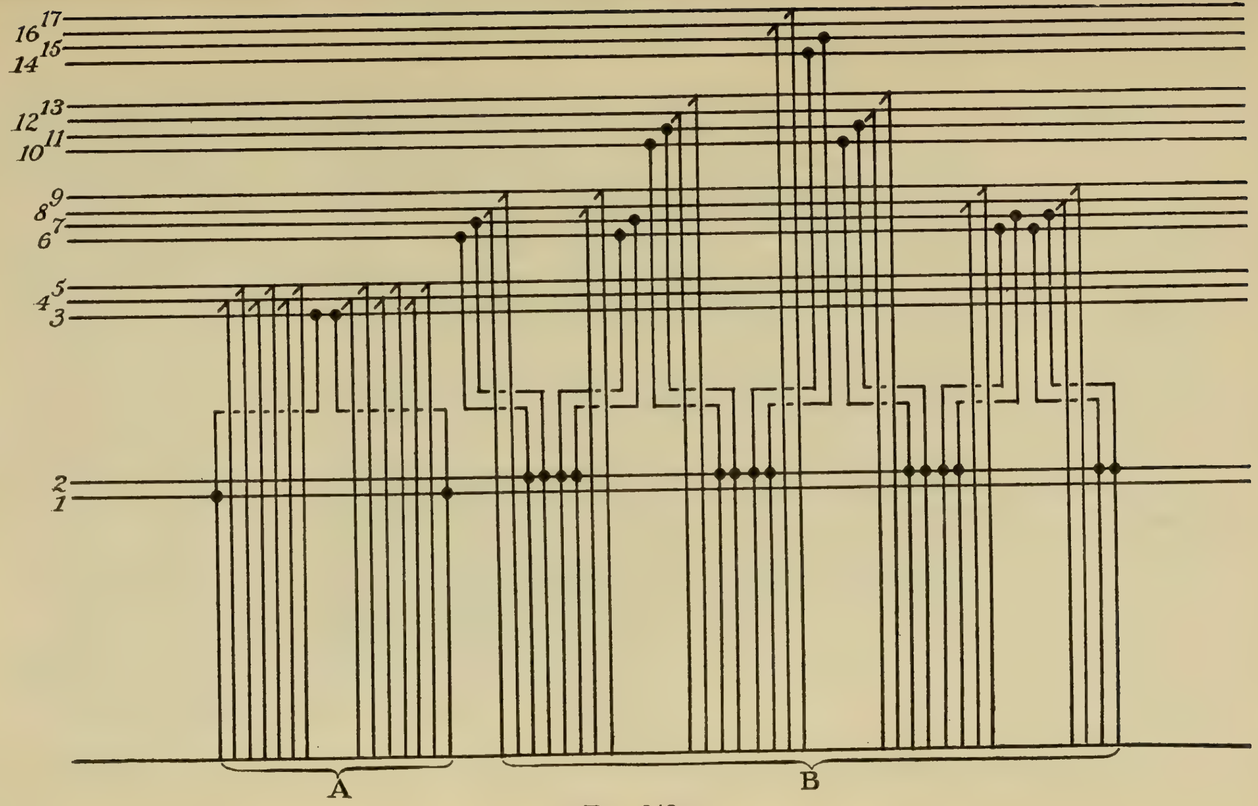


FIG. 343B.

in striped gauze cloths. It is a designing practice which consists in combining two or several systems of fabric construction. Each species of pattern forming the different lines in the style may be a distinct make of texture. Considering, for example, the specimen in Fig. 344, it is composed of plain, warp-figured and gauze elements, with each element specially

FIG. 344.—WARP-FIGURED GAUZE STRIPE.

set in the reed. Sections A have 16 threads per $\frac{1}{4}$ in., and sections B 32 ends, while sections C are produced by having four ends in one dent, two dents vacant and four ends in the fourth dent. The gauze threads interlace as sketched at Fig. 344A, wrapping with three plain lacing ends. The figured features are developed in extra warp yarns on a plain ground, or on the system given in Fig. 344B. For weaving the pattern, 20 shafts would be employed for striping B,

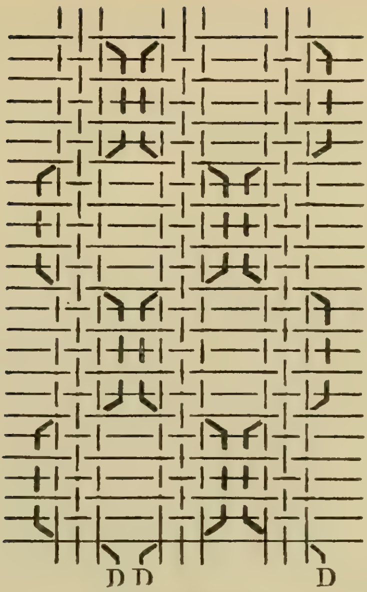


FIG. 344A.

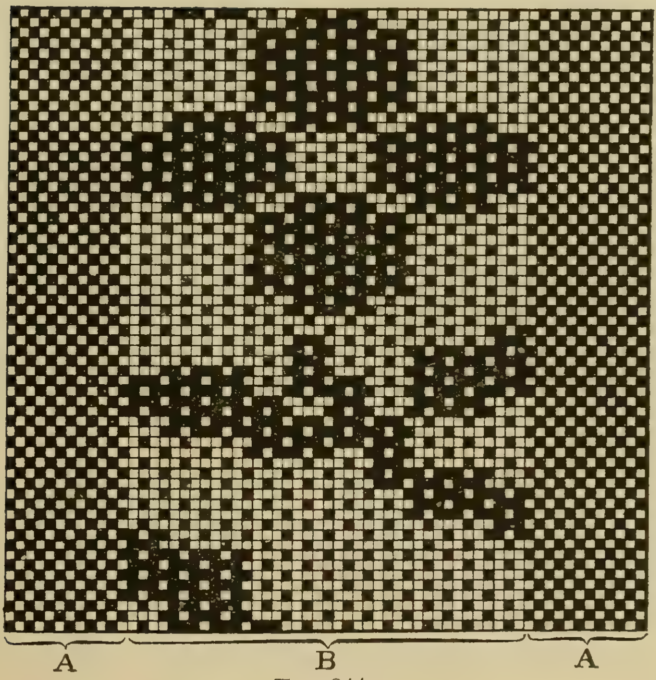


FIG. 344B.

or for actuating the figured warp, two shafts for the plain ground or stripings A, and two doup shafts with two vibrator bars for striping C.

In more decorative designs, harness mountings are used

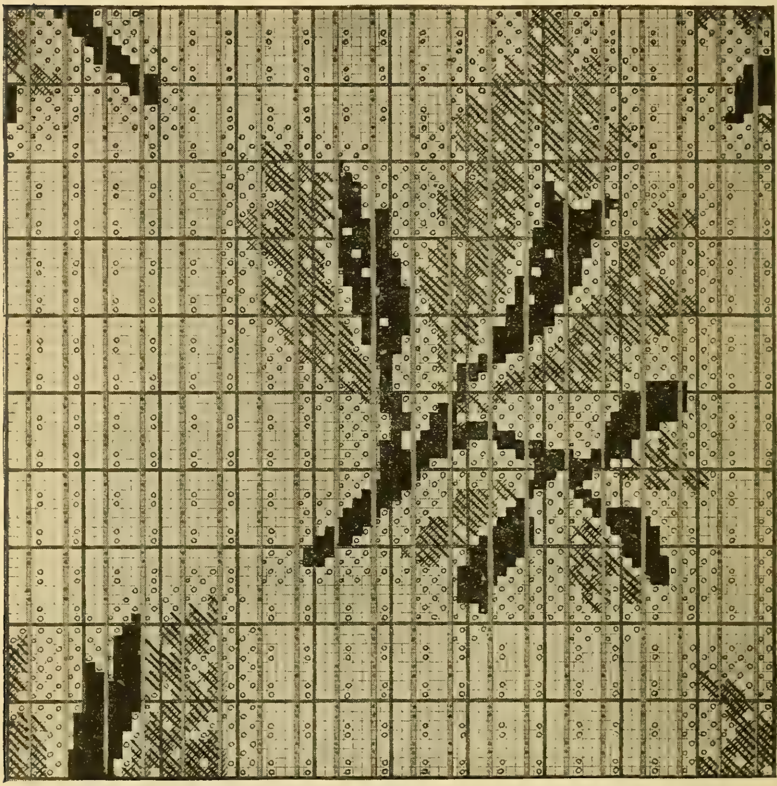


FIG. 345.—GAUZE FIGURED DESIGN FOR HARNESS MOUNTING.

for the figured portions, with shafts for the leno or gauze, lifted by special wires in the Jacquard machine, but depressed by springs, weights or under-motions.

309. *Harness Designs in Gauze Fabrics.*—Gauzes of the brocade variety are woven in Jacquard looms. One portion of the harness is worked in the ordinary manner, and a second

or front portion of the harness carries the slip mails, providing for warp drawing-in being done thus—

Thread 1	through	mail	1 of the back portion and also through mail 1 of the slip or front portion of the harness.
Thread 2	,,	,,	2 of the back portion of the harness.
Thread 3	,,	,,	3 ,, ,, ,, ,, ,, ,, ,,
Thread 4	,,	,,	4 ,, ,, ,, ,, ,, ,, ,, and also through mail 2 of the slip on front portion.
Thread 5	,,	,,	5 of the back portion of the harness.
Thread 6	,,	,,	6 ,, ,, ,, ,, ,, ,, ,,

This groups the cross wires in the machine in regular order—1, 2, 3, 4, 5, and 6. Six wires control four warp threads, which implies that they lift and lower both the stationary and doup harness cords, and may be arranged on point paper as in the simple form of design in Fig. 345. The drafting of the pattern, as far as the figured elements are concerned, may, therefore, be effected as in preparing plans for a straight harness mounting. The example has the spotting woven in warp and weft effect surrounded with bands of plain, while the ground is in leno, due to the slip threads rising on the two sides of the stationary yarns when lifted by the back and front portions of the harness respectively. In producing the figured portions of the designs, the slip harness remains inoperative.

The tensioning of the doup threads, in such harness weaving, may be done by passing them through mails weighted by lingos and arranged in a supplementary comber-board, fixed in the rear of the harness, or by means of vibrator bars. Harness gauze weaving is also practised in combination with pile and various types of warp and weft ornamentation, in which compound systems of warping, shuttling, and of loom mounting, are applied. For the dress trade, figured-gauze work is mainly confined to the lighter builds of cloth, more especially as composed of silk, cotton, and admixtures of silk and cotton yarns.

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